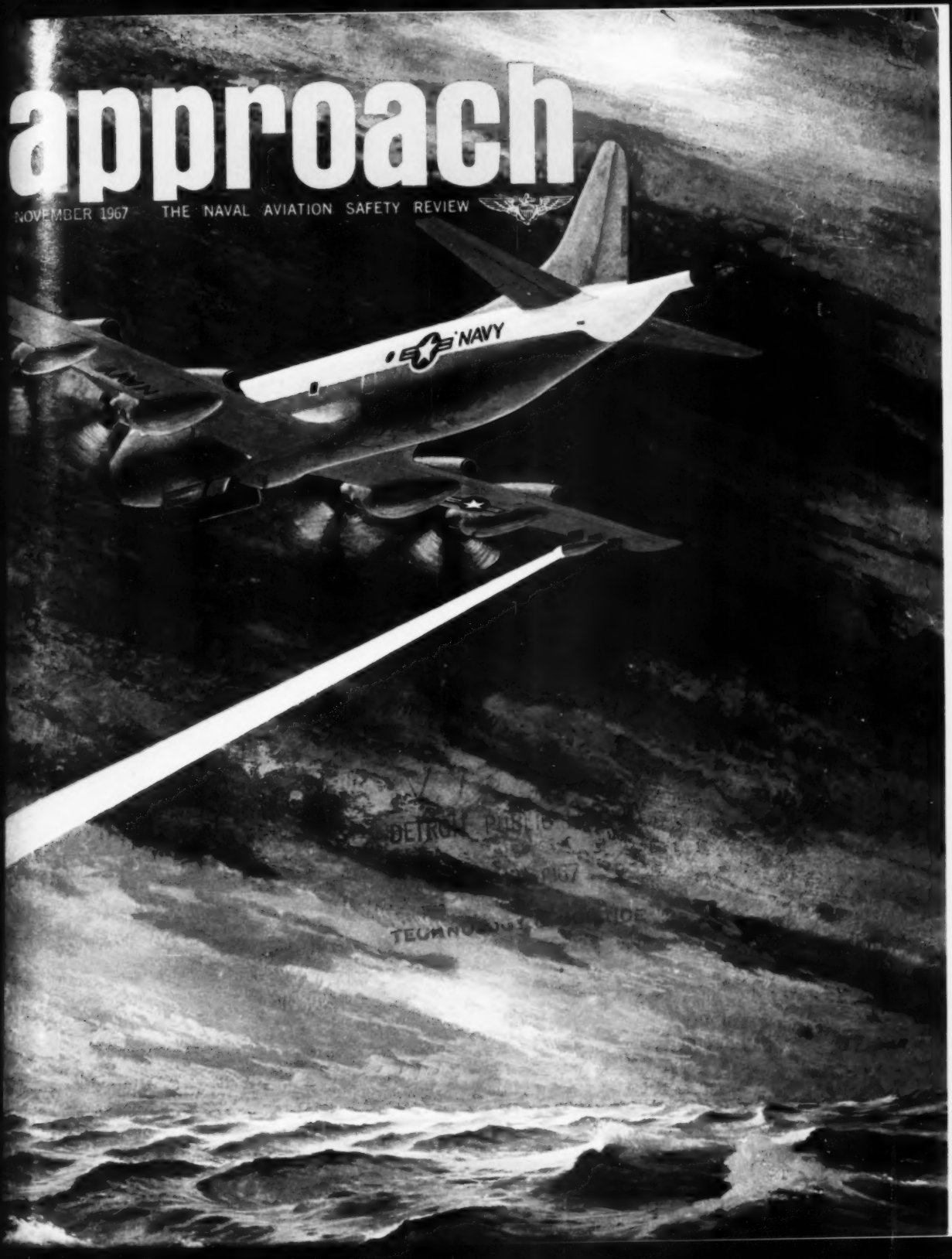
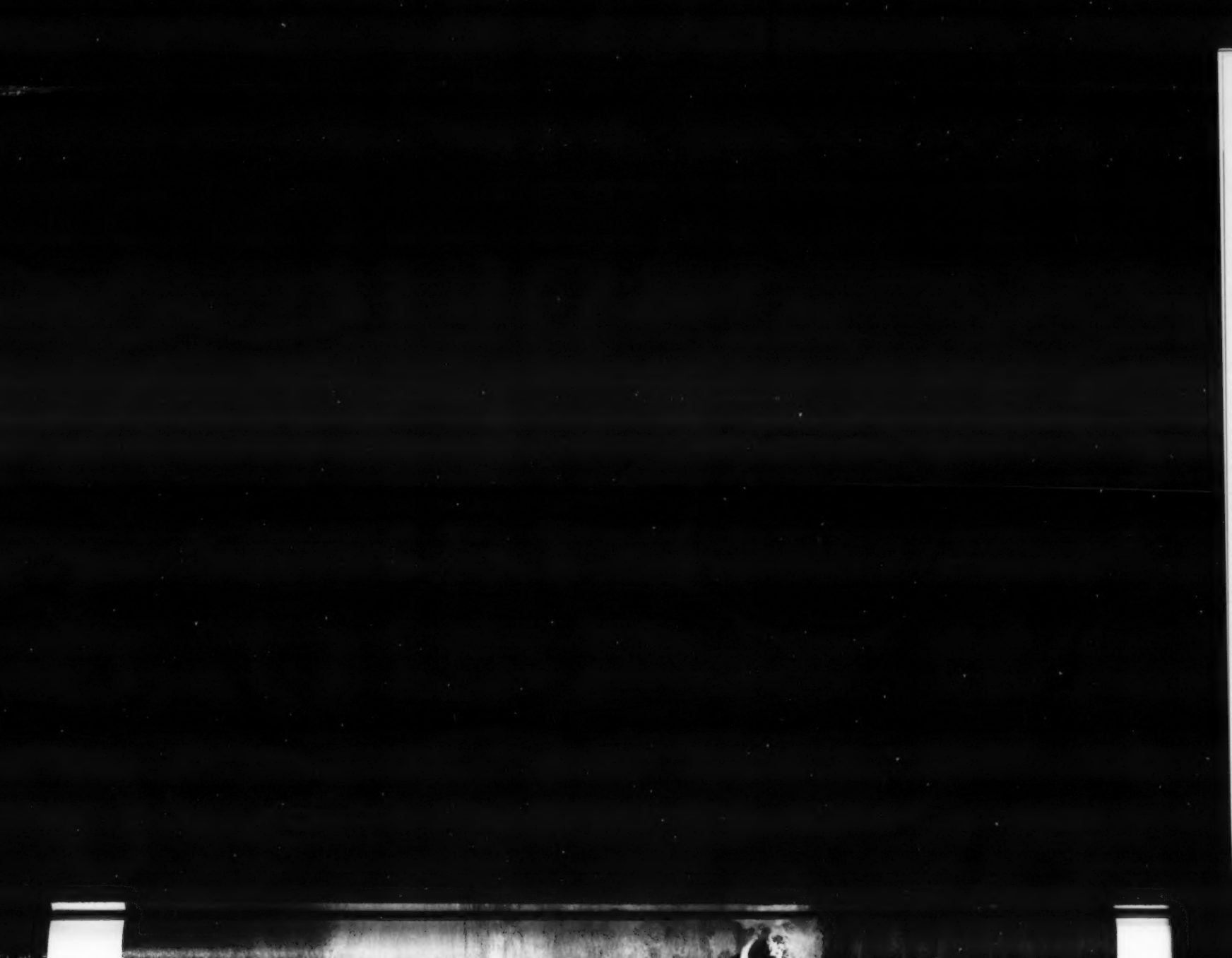
approach

NOVEMBER 1967 THE NAVAL AVIATION SAFETY REVIEW





Six Hours in the Water

After night launch, an SH-3A flew into the water unseen by observers on the carrier or in other aircraft. The air station alerted SAR units when the helo was not recovered at the appointed time. Poor visibility and fog complicated rescue operations.

The seriously injured copilot, his mae west punctured during impact, owes his life to his raft. The other two survivors, a passenger and an aircrewman, had no rafts. The passenger hung on to the copilot's raft and stayed afloat in his life jacket with help from a buoyant seat cushion. The aircrewman with both ankles fractured managed to survive with his life jacket alone, taking it off at times and using it as water wings to keep his head above water. After six hours, the three men were rescued.

Briefing at 0630, the SH-3A crew had flown to the carrier for carqual and plane guard duty with a noon return to the beach planned. The pilot, however, decided that they would remain for night bounce and plane guard. With little, if any, rest during the day, they briefed at 1745 and launched at 1841. Following night carquals, the helo assumed plane guard, joined at 2000 by a second helo from the air station. At 2302 after some 4½ hours' flying time and 7½ hours' total flying time that day, the SH-3A was recovered for hot refueling and relaunch to the beach along with the second helo. During hot refueling, three passengers boarded for the ride back.

After the two helos had become airborne and the flight had proceeded safely along an extension of the angle deck, a "foul deck" light was set aboard ship in PriFly and acknowledged by the Bridge. The ship reversed course to port and sight of the

helos was lost by PriFly due to the superstructure and was not regained. While the ship was in the port turn, the flight deck crew was exercised in a barricade rigging drill.

Starboard Turn

After launch at 2315, the helicopter climbed to 500′ and the pilot requested and was granted permission to turn to starboard. The surviving passenger, a qualified naval aviator who was sitting in the jump seat behind and between the pilot and copilot, had an unobstructed view of the left half of the pilot's instrument panel. The passenger watched the pilot begin a gentle starboard turn, then saw him move his head slightly and look out of the cockpit to the right. The passenger then looked down to cinch on his raft. He had failed to fasten his raft before launch although he had strapped in very securely and had pulled his hardhat chinstrap tighter than usual. He glanced back up and saw the altimeter descending smoothly through 125′.

"My recollection of the next several seconds is confused and perhaps unreliable due to my thinking about it," he told investigators after the accident. "It was apparent to me that we were going to fly into the water, yet I told myself we wouldn't because that sort of thing doesn't happen. I seem to remember yelling at the pilot to pull up, but I can't be sure. My eyes were glued on the altimeter. All the other instruments and the actions of the pilot and copilot went unnoticed as I watched the needle back from 100 to ZERO. I don't know how long this took but it happened very fast."

Impact and Break Up

Impact was moderate to severe in a slight nose down attitude. The aircraft broke up immediately and sank. Of the seven souls on board, three survived to be rescued. The copilot and jump-seat passenger found themselves in the water, free of the wreckage without unstrapping. The copilot had serious injuries, including four broken ribs and two badly cut fingers. The passenger's injuries were minor. Thrown forward in his seat into the sonar gear, the surviving aircrewman pushed himself back until the seat was upright, then unstrapped and literally stepped out of the sinking aircraft where the entire starboard side was gone. He had sustained fractures of both ankles.

The pilot cleared the aircraft with serious injuries but did not survive to be rescued. A second passenger did not survive the impact. A third passenger and the second aircrewman were not recovered.

The copilot remembers the impact like a dream; the front end of the aircraft came to pieces and he was hurled through the top. He remembers thinking that he had to get out fast since it was all broken up and would sink rapidly. Then he blacked out. When he regained consciousness, he was in his partially inflated PR-2 life raft. How he got there will never be known.

When the copilot inflated his life vest, the CO_2 escaped through rips and tears in the bladders. The oral inflation compartment was undamaged but because of his injured chest, he could not make use of the oral inflation tubes. For the same reason, he was unable to top off his life raft which had inflated only partially.

The surviving passenger does not remember any noise or flash on impact, only a sudden jolt which did not seem very severe. He held his breath, pulled his life vest toggles and floated to the surface. He had lost his helmet and had no raft.

Buoyant Seat Cushion

"I swam for the nearest object in the water which turned out to be a buoyant seat cushion," he recalls. "I clung to it the rest of the time in the water. I had never completed the job of fastening on my life raft in the aircraft before the accident so the cushion turned out to be a lifesaver."

He looked around to see where the carrier was and called for other survivors in the water but there was no answer. The lights of the ship looked a long way off.

"This was the first time it occurred to me that they hadn't seen the crash. I immediately lit a night signal flare which functioned properly. Shortly afterwards, someone nearby fired about six rounds of tracer ammunition. I remember thinking that the tracers seemed to be ineffective, being very small and disappearing rapidly. (Visibility was considerably reduced at this time.) I decided to save my other flare until rescue seemed more promising; someone had to have seen the crash and I figured there would be aircraft overhead shortly."

For the next half hour or so he experimented to find the best way to hold the seat cushion for maximum buoyancy with minimum energy.

"Even in the slight sea state I knew I needed that cushion," he said later. "I knew I wouldn't make it in the life jacket alone. Oddly enough, for all the time I worked at it, I can't remember now what position I decided on."

He continued to call for other survivors.

Survivors Join Up

After 1½ to 2 hours in the water, the copilot in his raft drifted down on the passenger. "Overjoyed at the prospect of company" the passenger joined up, hanging on to the raft with one arm and holding the cushion with the other. Except for brief periods,

they stayed like this until rescued.

Once, when the cold was "really getting to him," the passenger tried to get into the raft but it wouldn't hold both men. They worked out a system by which the copilot would hold the passenger's feet on the edge of the raft and the passenger would take this position for 10 minutes or so, even though it was fatiguing and the back of his head rested in the water. This helped a lot, he reports, and usually abated the uncontrollable shivering of his body. (Water temperature was 65°. There was no technical requirement for anti-exposure suits on this flight and none were worn. The condition of flight suits recovered indicated that anti-exposure suits would have been rendered ineffective by rips and tears in the crash.)

"We talked quite a bit upon meeting and for a while thereafter," the passenger recalls, "but as the hours wore on, it was work to talk and we ended with just enough to keep each other awake. It was surprising to me that there would be a tendency to sleep with all the tension and motion present but at times I became very sleepy. If it hadn't been for the copilot, I'm sure I would have dropped off." (*This was most likely the effects of the cold.—Ed.*)

"The passenger and I gave each other a lot of strength," the copilot states. "It would have been much more difficult alone."

Ships Appear on the Horizon

When the first ships appeared on the horizon, the two men waited until the distance seemed reasonable, then turned their strobe lights on. They had turned them off when it had seemed that all signs of possible rescue had disappeared in their area. When the aircrewman set off a Mk-25 smoke light which he had found in the water, the copilot and the passenger paddled over to look for him but they could not find him.

The aircrewman was in the same predicament as the passenger: he, too, was without a raft. On his escape from the aircraft, he had inflated his life vest but had lost both his raft and signal flares. When he saw the carrier in the distance, he fired the tracers which were seen by the passenger. Apparently, the Mk-25 smoke light which he ignited was not seen by shipboard personnel although it burned for several minutes. Several times, the aircrewman saw a strobe light flashing but he could not get to it. He did not leave his strobe light on all the time because "only one out of about three flashes was real bright."

Helo Flies Over

At this point a helo came over and turned on a spotlight.

"We figured we were saved right there," the survivor copilot said, "but the aircraft went right on by without seeing us. It was very demoralizing."

When the aircrewman heard the helo, he reloaded his .38 and turned on his strobe light. He fired five tracers but the helo left. Having expended nine out of his 10 tracers, he took the last and carefully loaded it to hold in reserve.

As it turned out, the helo had had to declare an emergency and return to the carrier because of an inflight fire. On the way to the carrier the helo copilot spotted a strobe light and a destroyer 1 to 1½ miles away from it. Passing on the word to the carrier to inform the DD about the strobe sighting, the helo landed, isolated the fire and launched again. The DD was searching the area when the helo arrived back on the scene. The helo crew respotted the strobe light and told the DD that the light was directly ahead. The DD was closer to the survivors than it had been so far.

Aircrewman's Problems

Meanwhile, the aircrewman had been having problems staying afloat.

"After I fired the second group of tracers, I guess I mostly went in circles for the next two hours," he recalls. "The seas weren't bad but I found that the life vest just barely kept my head out of the water. At times, I took off the life vest and put my chin on the back part of it and my arms over the front sides, using it as a sort of water wings. This helped and I drank less water. When my flight boots began to get too heavy after several hours, I took them off and they sank."

When the aircrewman saw the destroyer, he fired his last tracer at it. The DD turned its spotlight on

him. He was 200 yds off the port bow. The motor whaleboat was lowered, picked him up and returned to the destroyer.

Falls Out of Raft

The remaining two survivors were located minutes later.

"We were blowing 'SOS' on our whistles and screaming 'Help!' " the copilot recalls. "I was trying to turn over on my stomach so that I could call to the DD with my hands cupped like a megaphone when I fell out of the raft. I thought I was finished right there because I sank like a rock. I figured I would give the best I could, so I struggled to the surface and put my hand through a hook in the raft. I was very panicky at that time. I was getting tangled in a strap hanging from the raft but I finally got into the raft and began to blow a whistle." (The passenger had given his whistle, his last piece of signaling equipment, to the copilot whose hands were free. They learned later that the whistle was heard aboard the destroyer.)

As the DD approached, the copilot tried to light a flare but it did not work. The passenger lit one which functioned properly but the ship did not alter course.

The helo saw the raft but because of the fog bank and clouds could not maintain contact. The helo continued to circle the destroyer which picked up the raft in its lights.

"For the first time then," the passenger states, "I realized how low the ceiling was and what a remarkable job the helo crew had done in locating us."

The DD turned toward the survivors and the motor whaleboat picked up the two men at the raft. By 0730 all three survivors had been transferred from the DD to the carrier by the same helo which had spotted their strobe lights in the water.

Excellent Physical Condition

"The survival of these three men can in part be attributed to their excellent physical condition prior to the accident and a series of lucky circumstances," the investigating flight surgeon states. "The copilot with an inoperative life vest survived six hours in the water on a life raft. The passenger survived because he was able to find a buoyant seat cushion in the debris and the crewman survived using his life vest alone."

The strobe lights were invaluable, the flight surgeon says. However, as the first endorser states, "Survivors of this accident were so concerned about the life expectancy of their strobe light batteries that they did not have these lights turned on during most of the time they were awaiting rescue in the water. Their plan was to activate these lights only when they observed or heard search activity. With only six hours of darkness facing them that night (the accident occurred at 2324) and with slight hope they could survive the effects of exposure into the following night, they should have maximized the use of their strobe lights during the initial six hours of darkness."

The squadron tested six representative strobe lights to battery exhaustion. The earliest battery failure was at 24 hours; the average life was 27 hours. In this connection, it should be noted that the Navy has not established a shelf life for the strobe light. (*See Personal Survival Equipment Crossfeed 4-66 for battery test procedures.—Ed.*)

Survival Recommendations

Among the board's recommendations in the realm of survival equipment were:

- That buoyant items, such as seat cushions, be equipped with straps to facilitate their use as flotation devices.
- That all flight personnel be equipped with PRC-49 survival radios or a comparable piece of equipment.
- That flight crew personnel be equipped with personal skin diver type wet suits vice Mk-5 anti-exposure suits.

It was also recommended that "Pinger," a self-contained, salt water-activated underwater transmitting device, be further investigated as a means of locating survivors and/or aircraft wreckage by use of helicopter and shipboard sonar passive receivers.

The first and second endorsers particularly concurred in the board's approval of the wet suit.

"The advantages of the wet suit over the Mk-5 anti-exposure suit are obvious in an accident such as this" the second endorser wrote. "Inadvertent collision with the water is unfortunately a recurring type of accident for carrier based aircraft. A survival suit must be devised that will meet the requirements for this type of flying and which a pilot can wear without becoming unduly fatigued from heat, bulkiness, and restricted movements. This should be a suit that will be comparatively cool to wear before flight, does not cause the pilot to overexert himself in preflighting the aircraft, yet that will afford protection for a reasonable time after water entry, is comparatively inexpensive and is readily available at the present time." The second endorser recommended that funds and authority be granted to commanding officers to outfit their squadron personnel with "an appropriate type of survival suit that will afford protection even though torn and ripped."

ONCE A KNIGHT'S ENOUGH

"Forsooth," sayeth the knight, and rose from the round table. "Mine IN basket hath emptied into the proper channels. Now is the time to mount the iron bird and soar forth. The month end approacheth and I am short the fourth hour."

So saying, the warrior arose from his desk, zipped into his armor and left that place of cubicles. He traveleth to the place of the roaring birds, signeth the necessary forms and strappeth on a canvas bag. Striding around the winged monster, he pulleth here and poketh there in a manner to checketh the firmness of the fowl's feathers.

Seemingly pleased with the condition of the beast, the knight mounted and did various things to the bird's interior which caused it to roar and shake. It waddled off to a stretch of black earth, took a running leap and soared upward with a rush of wind.

And there cometh a feeling of great joy to the knight. He zoometh around the sky with abandon until an hour had gone and it were time to returneth the bird. The warrior descended from high places and flew beside the black earth, causing the bird to cease its roar. He turneth it toward the alighting path and pulled down some feathers along the back of each wing. As the bird approached the ground, it was seen that one wing flew lower than its mate. Some said this was because the wind blew across the black earth.

The bird alit on one foot, whereupon it launched itself into the air again, turned its nose into the wind, and lit hard to the extent that its legs spreadeth on the hard ground. Its whirling nose bit angrily into the black earth and the beast cast one wing down and slid along on its belly. The iron monster came to a grinding halt and a great quiet descended upon the place. The knight dismounted and woefully regarded the crumpled bird.

And there came a troop of castlemates calling themselves investigators, and they took measurements and did all manner of things to the broken bird. And all who witnessed the falling of the bird were called and spake long to them and they writeth in the book.

Then he of the gray beard speaketh to the knight in this manner:

"Verily, verily, I say unto thee, thou hast lost all directional control and it were better that thou hadst taken this bird again around. It is written that he who bounceth shall encounter the crooked path. 'Tis far better to push the throttle than boot the rudder, for the spur is quicker than the rein.

"However, the records of thy form indicate thou hast only seven and a half hours of bird time in the last few months. For this, thy supervisor shall be called to task.

"Go, and when thou comest again to the bird, bring thy senior knight that he may instruct thee how to alight thy bird with safety."

—Adapted from U.S. Army Aviation Digest

Why Alternate Airports?

Regarding alternates, OpNavInst 3710.7D says, "An alternate airfield is not required when the weather at the destination is forecast to be equal to or better than 3000′ ceiling and 3 miles visibility during the period one hour before until one hour after the ETA. Otherwise, an alternate airfield is required."

The below listed chart is the weather criteria for IFR clearances as delineated in OpNavInst 3710.7D.

DESTINATION		ALTERNATE	
VOR, TACAN, ADF, ASR, LF RANGE	ILS, PAR	VOR, TACAN, ADF, ASR, LF RANGE	ILS, PAR**
Published Landing Minima	Published Landing Minima*	Three hundred feet ceiling and one mile visibility both above published landing minima	Two hundred feet ceiling and one half mile visibility both above published landing minima

*Single-piloted aircraft: Not less than 200 feet ceiling/one-half mile visibility.

**Single-piloted aircraft and those multi-piloted aircraft equipped with only one operative means of two-way voice communication: Not less than published ADF, VOR, TACAN, or LF RANGE minimums as applicable to installed equipment/NAVAIDS available (applicable to PAR only).

Regardless of weather conditions, experienced aviators have found it prudent to be knowledgeable about all airports along a planned route and their facilities in the light of an emergency. As everyone knows, an emergency can be caused by many things, some of which are: insufficient fuel, engine trouble, radio malfunction, oxygen and cabin pressurization difficulties, and below minimums weather at destination.

Ceiling zero, visibility one quarter. . .

Weather is the biggest single reason for alternates and within that category, fog looms high on the list. Fog is often like a ghost because it can suddenly appear as well as disappear just as mysteriously. Sometimes it will blanket an entire area and other times it will manifest itself in shifting, unpredictable patches. Above the low lying fog, the weather is often VFR. It is frustrating to airmen to look down and have to admit that the ground-hugging clouds can make the safe return to earth most precarious. And when bits of the ground can be observed intermittently, many pilots hate to give up a landing attempt under tempting conditions where fast forming fog can frustrate fast moving flyers.

Penetrating Known Fog Conditions

Two pilots flying separate F-8C aircraft were determined to reach a destination, just after dark, which was IFR because of intermittent fog. Other than the low lying misty hindrance, the weather was generally VFR. The flight plan briefing marked the terminal location to be 200′ overcast and one-half mile visibility in rain and fog. Landing minima for the destination was published as 400′ and one mile. The selected alternate was VFR (8000′ overcast with intermittent clouds down to 3000′) five miles visibility and it was forecast to hold VFR. There was speculation that the desired terminus would improve so the section blasted off, encouraged by VFR conditions of the alternate some 113 miles beyond.

The section was encouraged enroute by two radio checks on the destination's weather. Both reports from an intermediate center were 400′ and four miles but the alternate had deteriorated to 2400′ while visibility held at 5 miles.

About 100 miles from the destination, approach control split the two *Crusaders* for individual approaches. When the first plane was descending to 2000′, the pilot was informed that his destination weather had dropped to ". . . 200′ overcast, visibility 2 miles in very light rain and fog . . ."

Soon thereafter, the second pilot had reached 2000′ and was being maneuvered in odd holding patterns further out in a dirty condition. He was on the same frequency as the first plane so there was occasional confusion in call signs, who was who and where.

The first pilot was turned over to the GCA final controller and was given a slight bit of a shock by being told that the field weather had rapidly deteriorated to 200′ and ¼ mile visibility. Before this could influence him, however, he got his runway

visual and made a routine landing. He later reported that the rotating beacon on the tower had been a distinct detriment to his vision on final, and that the weather was not as bad as reported, in essence, not below the precision minimums.

Meanwhile the second pilot was being further confused by many unorthodox radar-directed orbits about 15 miles out at 2000′. Just about the time the first pilot landed, the second one transmitted, "Roger, I'd like to get in. I'm going to have to bingo out of here. You've already burnt up 1500 pounds of fuel since I dirtied up." Four minutes later, the GCA final controller took over. When almost three miles from touchdown, the pilot was told, ". . . the ceiling is reported at zero visibility, one mile, correction one-quarter mile . . ."

When at field precision minimums, the second pilot could not see the runway so he transmitted, "Executing a missed approach, I'd like to file direct to . . . (Alternate)." He then informed GCA that his fuel state was 2000 pounds and GCA transmitted, "Roger, do you want to try another approach or . . .?" The immediate answer was, "let's give it one more try."

Press on Regardless

GCA came back with, ". . . okay, the existing weather is ceiling zero, visibility one quarter, over." Then after several discussions as to why he missed, the pilot said, "Roger, I saw the runway, it was (the) lineup that got me." This snap view of the runway, weak as it appears to have been, seemed to overshadow the extreme violation of NATOPS weather minima. Regardless, three minutes later, the pilot re-entered the final and one mile from touchdown the final controller gave him a waveoff for being well below glidepath and well to the right of centerline. Apparently, determination to land nullified any fear of the dangerous ". . . below the glidepath . . ." messages which the pilot heard in quick succession three times. He just answered, "Give me the heading, I'm just going to keep coming in."

The GCA controller kept doing his part and the lucky pilot saw the runway about 1000′ on his right quarter 200′ down. The wallowing *Crusader* in the landing configuration survived the hairy S turn and the pilot reduced power when lined up with the runway. A moment later, the sink rate became too high and the pilot added power. The engine response was normal but the pavement was too close resulting in a very hard landing. Nevertheless, the gear held for the rollout. Aerodynamic braking was followed by wheel braking. The hook was lowered and engine secured. The emergency arrestment worked as advertised when the chain gear stopped the overly strained *Crusader*.

A thoroughly bent Cougar.

The landing gear and the underside of the aircraft required repairs before the aircraft went home a few days later.

This hairy tale could end here since no one was hurt and the aircraft received only minor damage. There are, however, a number of safety lessons hidden in this narrative. Both pilots violated NATOPS flight procedures by landing when the field was below published minima, which unfortunately, occurred as if by magic while in the GCA landing pattern. The second pilot seemed dangerously complacent to the "below glidepath" messages when he said, ". . . I'm just going to keep coming in."

Fate was further aggravated because the F-8 is hardly the airplane to be doing last minute S-turns

so close to the ground in the landing configuration.

The Sudden Appearance of Fog

Unpredictable fog tripped up two pilots in a TF-9J on a *very extended* cross-country. They departed on a plan to make an intermediate fuel stop enroute to final destination. Cruising along in beautiful VFR twilight weather at FL 370, the enroute fuel consumption was checked and revealed that they were 1300 pounds ahead of the flight plan calculations. A contact with ATC revealed that, indeed, they were in a very favorable jet stream and it continued almost to final destination which was distinctly VFR. Consequently, the flight plan was changed to go all the way home nonstop and quick Rest computer calculations revealed there would be 500 pounds of fuel to spare direct to destination.

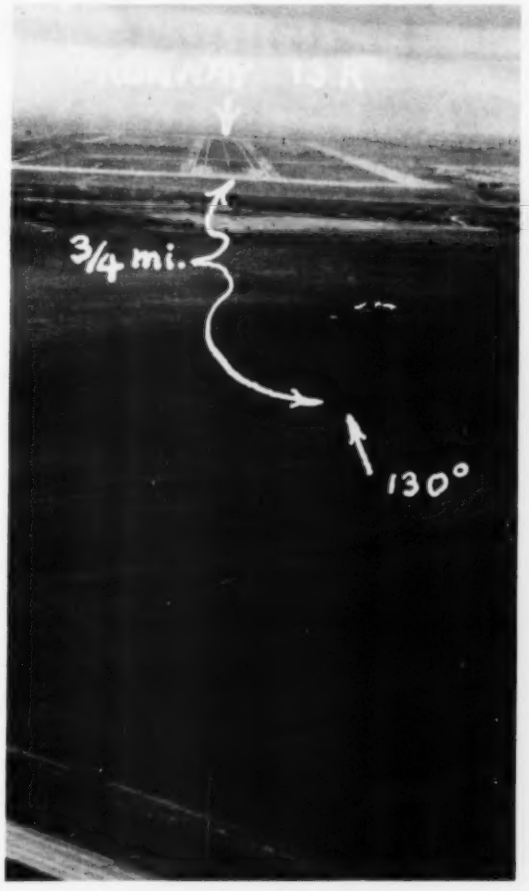
The first hint of trouble occurred when checking in with ATC 150 miles out. Fog was reported at the destination although the overall condition was clear and 10 miles visibility.

At 50 miles, homebase tower advised that the field had suddenly gone IFR because of rapidly forming ground fog reducing visibility to 1/16 of a mile. Because of low fuel state, the senior pilot declared an emergency and was cleared in under the control of surveillance approach radar. GCA was not set up on the existing duty runway. At the 6-mile point, altitude was 2000′ and the field lights were visible in spite of the patchy ground fog. Unfortunately, the approach required a steady descent and the aircraft entered a fog bank, at 700′, obscuring the field. A few seconds later, the *Cougar* pancaked into a plowed pasture about half a mile short of the runway. The aircraft alternately slewed and rolled while shedding its wings before coming to a flameless stop. The crew emerged unharmed.

When informed 50 miles out that the destination had gone IFR, the crew should have immediately sought an alternate; and one was available with VFR conditions. It was slightly to the left of the course and 10 miles closer, But—, get-home-itis intervened and the decision to pass it by struck an expensive airplane.

Both the narratives related in this article occurred shortly after dark when fog is known to be most prone to form. With their destination already IFR due to fog, the pilots were tempting fate to press on considering the time of evening.

The *Cougar* pilots were flying in very fine VFR weather which tends to lend itself to complacency. Like the F-8 pilots, their time of arrival was also just after dark. Moreover, they were given a meaningful clue 150 miles out when told by ATC that although their destination was clear and 10 miles,



The runway that the fog obscured.

ground fog was forming in the area. Fifty miles out, fact, not fate offered them a second chance to consider another place to land because their destination had suddenly and definitely gone IFR.

Most naval aviators will return to base or a suitable alternate as soon as safely possible when there is a malfunction. Although weather is not a mechanical part of the aircraft, it should be considered in the same category of overall trouble. Consequently, regardless of flight plan type, always have an alternate in mind for any and all emergencies that may appear on the scene.

As a matter of record there were 25 actual accidents to naval aircraft (with some fatalities) from 1 Jan 1965 to 30 Dec 1966 (two years) wherein pilots landed short on radar controlled IFR approaches.

Training Command Wins CNO Readiness Through Safety Award

The CNO Safety Award is presented annually to the one major command whose contribution to "Readiness Through Safety" throughout the fiscal year was adjudged most significant by the Chief of Naval Operations. The trophy for fiscal 1967 went to the Chief of Naval Air Training, in recognition of the outstanding performance displayed by all functional units of his command. These units are under the leadership of the Chief of Naval Air Basic Training (CNABATRA), Chief of Naval Air Advanced Training (CNAVANTRA), Chief of Naval Air Reserve Training (CNARESTRA) and Chief of Naval Air Technical Training (CNATECHTRA).

In announcing the award, Admiral T. H. Moorer, Chief of Naval Operations, cited professionalism and good management at all levels of the Training Command as key factors in its successful achievement. "It is a pleasure to congratulate the Chief of Naval Air Training and the top performing units of his command on winning this coveted award. CNATRA bettered its performance last year by flying more hours and simultaneously reducing the Naval Air Training Command accident rate by 10.8 percent. This significant contribution to readiness through utilization and conservation of assets is clear evidence of astute management and professionalism at all echelons. Well done."

CNO
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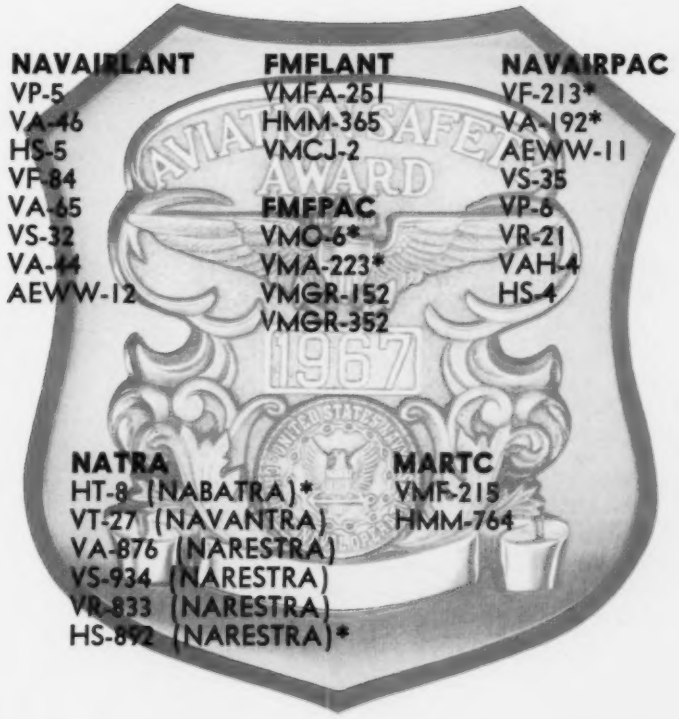

NAVAIRLANT
VP-5
VA-46
HS-5
VF-84
VA-65
VS-32
VA-44
AEWW-12

FMFLANT
VMFA-251
HMM-365
VMCJ-2

FMFPAC
VMO-6*
VMA-223*
VMGR-152
VMGR-352

NAVAIRPAC
VF-213*
VA-192*
AEWW-11
VS-35
VP-6
VR-21
VAH-4
HS-4

NATRA
HT-8 (NABATRA)*
VT-27 (NAVANTRA)
VA-876 (NARESTRA)
VS-934 (NARESTRA)
VR-833 (NARESTRA)
HS-892 (NARESTRA)*

MARTC
VMF-215
HMM-764

*Denotes consecutive awards

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VA-35*
VA-43*
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VF-11
VF-41
VP-7*
VP-8*
VP-10*
VP-11*
VP-21*
VP-23*
VP-24*
VP-26*
VP-30*
VP-44*
VP-45*
VP-49*
VP-56*
VR-1*
VR-24*
VRC-40*
VS-24
VS-27*
VS-28*
VS-30*
VS-31
VS-34*
VS-39*
VW-4*
VX-1*
VX-6
VX-8
HS-1*
HS-11*
RVAH-1
RVAH-5
RVAH-13

COMNAVAIRPAC

VA-55
VA-144*
VA-153
VA-165*
VA-196
VA-215
VAH-10*
VAH-123*
VC-3
VC-7
VF-21
VF-126*
VF-161
VP-1*
VP-2*
VP-17
VP-22*
VP-28*
VP-31*
VP-42*
VP-46*
VP-47*
VP-48*
VR-30
VRC-50
VRF-32
VS-25*
VS-23*
VS-33*
VS-37*
VS-38*
VS-41*
VW-1*
VX-4*
VX-5*
HS-10*

CGFMFLANT

VMFA-513
VMGR-252
VMT-1*
HMM-513

CGFMFPAC

VMA(AW)-533
VMCJ-1
VMFA-542
HMM-163
HMM-165*
HMM-262
HMM-361*
HMM-364*
HMH-463
HMMT-301
H&MS-11*
H&MS-13*
H&MS-15*
H&MS-30*
H&MS-33*
H&MS-36
H&MS-37

CGMARTC

VMF-321	VMA-611	VMR-234*	HMM-768*
VMA-131*	VMJ-4*	VMR-353*	HMM-770*
VMA-142*	VMO-4*	HMM-761	HMM-772*
VMA-233*	VMR-216*	HMM-766*	HMM-776*
VMA-543	VMR-222*	HMM-767*	HMM-777*

CNATRA

CNABATRA	CNAVANTRA
VT-5	VT-23
VT-6*	VT-25
VT-7*	VT-28*
USS LEXINGTON*	VT-29*
	VT-31

CNARESTRA

VA-725*	VP-701*	VP-822*	VP-935*	VR-771*	VR-912*	VS-874*	HS-871*
VA-773	VP-702*	VP-831*	VP-936*	VR-772*	VR-913*	VS-891*	HS-872*
VA-791*	VP-703*	VP-832*	VP-937*	VR-773*	VR-931*	VS-892*	HS-911*
VA-813*	VP-721*	VP-833*	VR-661*	VR-774*	VR-932*	VS-893*	HS-912*
VA-821*	VP-722*	VP-834*	VR-662*	VR-792*	VR-933*	VS-912*	HS-931*
VA-822*	VP-723*	VP-835	VR-663*	VR-793*	VR-934*	VS-914*	HS-932*
VA-831*	VP-724*	VP-837*	VR-671*	VR-811*	VS-661	HS-701*	HS-933*
VA-832*	VP-725*	VP-871*	VR-672*	VR-812*	VS-663*	HS-702*	
VA-861*	VP-726*	VP-872*	VR-673*	VR-813*	VS-721*	HS-721*	
VA-871	VP-741*	VP-873*	VR-701*	VR-821*	VS-722*	HS-722*	
VA-873*	VP-742*	VP-874*	VR-702*	VR-822*	VS-724*	HS-723*	
VA-881*	VP-771*	VP-875*	VR-703*	VR-831*	VS-733*	HS-731*	
VA-882*	VP-772*	VP-876*	VR-704*	VR-832*	VS-734*	HS-732*	
VA-911	VP-774*	VP-878*	VR-721*	VR-834*	VS-735*	HS-733*	
VA-912*	VP-775*	VP-881*	VR-722*	VR-861*	VS-741*	HS-741*	
VF-661*	VP-776*	VP-882*	VR-723*	VR-862*	VS-743*	HS-742*	
VF-662*	VP-777*	VP-883	VR-724*	VR-871*	VS-751*	HS-751*	
VF-672*	VP-778*	VP-891*	VR-731*	VR-872*	VS-752*	HS-752*	
VF-673*	VP-791*	VP-892*	VR-732*	VR-873*	VS-753*	HS-771*	
VF-703*	VP-793*	VP-893*	VR-733*	VR-874*	VS-771*	HS-773*	
VF-932	VP-811*	VP-911*	VR-734*	VR-881*	VS-772*	HS-811*	
VP-662*	VP-812*	VP-912*	VR-741*	VR-882*	VS-774*	HS-812*	
VP-663*	VP-813*	VP-913*	VR-742*	VR-883*	VS-776*	HS-813*	
VP-671*	VP-814*	VP-915*	VR-743*	VR-893*	VS-863*	HS-821*	
VP-672*	VP-816*	VP-933*	VR-751*	VR-894*	VS-864*	HS-831*	
VP-674*	VP-821*	VP-934*	VR-752*	VR-911*	VS-872*	HS-832*	

OPNAVINST 3710.7D—NATOPS Manual—General Flight and Operating Instructions—has superseded OpNavInst 3710.7C. Several important changes have been incorporated in the Instrument Flight Clearance Procedures section and the following questions are based on the new criteria.

ON THE GLIDE SLOPE

1. Is an IFR clearance based on existing or forecast weather for the enroute, destination and alternate phases?

■ **Forecast weather, if it is available. "IFR clearance shall be based on the actual weather at the point of departure, at the time of clearance, and forecast weather enroute and at both the destination and destination alternate during the period one hour before until one hour after ETA. Existing weather may be used as a basis for clearance when no forecast is available and the pilot's analysis of available data indicates satisfactory conditions for the planned flight."**

2. What is the requirement for an alternate airfield on an IFR clearance?

■ **3000′ X 3 mi for ETA±1 hr. "An alternate airfield is not required when the weather at the destination is forecast to be equal to or better than 3000′ ceiling and 3 miles visibility during the period one hour before until one hour after ETA. Otherwise, an alternate airfield is required."**

3. What weather minimum is necessary to commence an instrument approach at a destination airfield?

■ **Published landing minimums, except in the case of single-piloted aircraft which must have not less than a 200′ ceiling and one half mile visibility for PAR or ILS approaches.**

4. What weather minimum is necessary to commence a section approach at a destination airfield?

■ **Circling approach minimums, if they are authorized. In the event a circling approach is not authorized, VFR minimums apply.**

5. Under any circumstances, may an IFR clearance be authorized to a destination airfield which is forecast to be below landing minimums for the ETA+1 hr?

■ **Yes. When an alternate airfield is available which is forecast to be equal to or better than 3000′ ceiling and 3 miles visibility during the period one hour before until one hour after the ETA.**

CFAD has the authority to clear fleet aircraft when weather conditions are below IFR mini-

mums, or forecast to go below IFR minimums, and operational commitments so dictate.

6. When an ADF approach is executed to a PAR final, how many approaches may be logged?

■ Two.

7. When shall a pilot's instrument rating be renewed?

■ Within 60 days preceding the pilot's birthday, with the following exceptions. In the case of a pilot ordered to replacement training whose instrument rating will expire while he is in training, the instrument rating renewal may be delayed until the pilot achieves NATOPS qualification in the model aircraft for which he is undergoing training.

Type commanders may, upon request, extend the expiration date of instrument ratings issued to pilots of single-piloted aircraft which otherwise would expire during the period of a long deployment. In such cases, pilots concerned must complete a formal instrument course within 90 days after return from such deployment.

Pilots on duty outside the continental limits of the United States where facilities are not available for maintaining flight proficiency, and minimum annual flying requirements have been waived by the Chief of Naval Operations/ Commandant of the Marine Corps, are exempt from the requirement to maintain instrument ratings. Pilots returning from duties where a valid instrument rating could not be maintained shall be granted a period of 6 months in which to qualify.

8. When an aircraft is radar vectored to a tacan final approach, how many approaches may be logged?

■ One.

9. According to OpNavInst 3710. 7D, is the readback of an ATC clearance mandatory?

■ Yes, section 624b states, in brief, that pilots of aircraft departing on IFR flight plans shall read back the ATC clearance to insure receipt as issued.

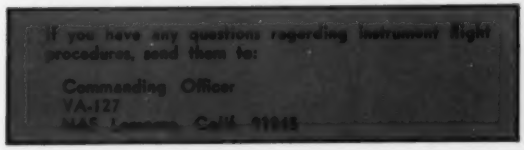
10. What items constitute the minimum required articles to be included in instrument navigation packets?

■ 1. Appropriate Flight Information Publications
2. Navigation computer
3. Navigation flight log forms
4. Appropriate aeronautical charts

11. Is a single engine aircraft with tandem flight controls considered a single-pilot or multi-pilot aircraft?

■ It can be either, depending on application. For purposes of flight records and reports, the aircraft is considered multi-piloted. Section 401 of OpNavInst 3710. 7D states that multi-pilot aircraft are "aircraft, either multi-engine or single-engine, having two flight control positions or having only one flight control position but also having another position in the pilot compartment requiring copilot duties to be performed."

For flight clearance purposes the aircraft is single-piloted. Section 563 of OpNavInst 3710.-7D states that, "tandem cockpit aircraft are considered as single-piloted aircraft regardless of the number of pilots embarked."



The cause of this problem is static temperature depression due to high velocities in the engine inlet duct. If your eyebrow is still raised, you'd better keep reading. The purpose of this article is to acquaint pilots of gas turbine powered aircraft with the mechanism of warm air icing and to give some definition to the atmospheric conditions where icing at first thought may not seem to be possible. The point is that engine inlet icing can occur at OATs as high as 60 to 65°F.

First, we'd like to pose a few questions and give the straightest answers we can, based upon testing experience:

'Would you believe.

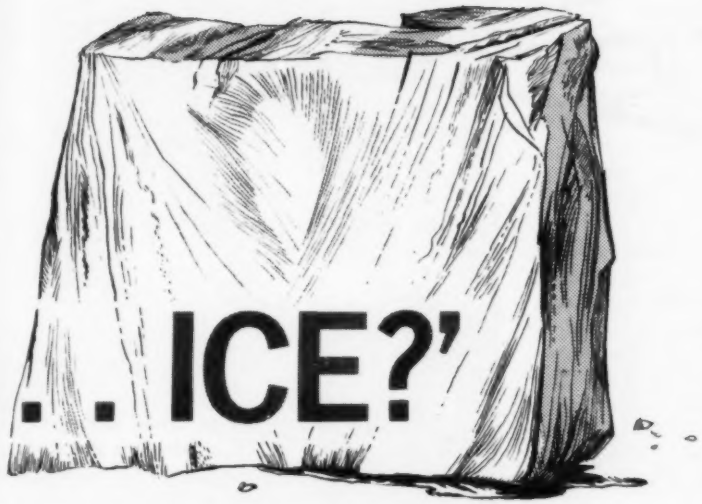
Would you believe that during damp or wet weather ice can form on the inlet of a turbojet engine when the outside air temperature (OAT) is 20 to 30°F *above* freezing? Mr. Naval Aviator, you'd better believe it!

Question

1. Can engine or inlet duct icing occur when there are no signs of wing ice?
2. What can happen as a result of this warm air icing?
3. Can warm air icing exist at OATs above freezing?
4. Will anti-icing air prevent ice from forming at the compressor inlet?
5. Will engine anti-icing air prevent the inlet duct from icing?
6. Are there commercially available devices for detecting the formation of ice in inlet ducts?
7. What can you do to avoid inlet duct warm air icing in damp or wet weather?

Answer

1. Yes.
2. Severe FOD (See Figure 1).
3. Yes. It has been encountered on inlet ducts at OATs up to 63° F.
4. Yes.
5. No.
6. Yes. And they have been used successfully for this purpose but are not in fleet use.
7. Fly the airplane faster, go to a warmer altitude, or get out of the damp wet weather. Avoid low airspeed and high power setting combinations whenever you can. *A-4 pilots—use figure 3.*



By Eric Lister
Naval Air Propulsion
Test Center

It should be noted that the NATOPS Flight Manuals for the A-6A and A-4E aircraft both recommend avoiding icing environments whenever possible and using anti-icing air otherwise. *This article affirms the NATOPS procedure above and serves to define the conditions where icing can occur at OATs above 32°F.*

Here's an example of one pilot who was flying through precipitation. Altitude static temperature was 41°F. OAT at his flight speed was 49°F. Anti-icing air was not used. About five minutes after entering this precipitation, he experienced several loud bangs and overlimits EGT. He made a safe emergency landing at a local municipal airport. The engine, however, was in pretty sad condition due to FOD. Figure 1 shows a photo of the banged up leading edges on the first stage compressor rotor blades of this engine.

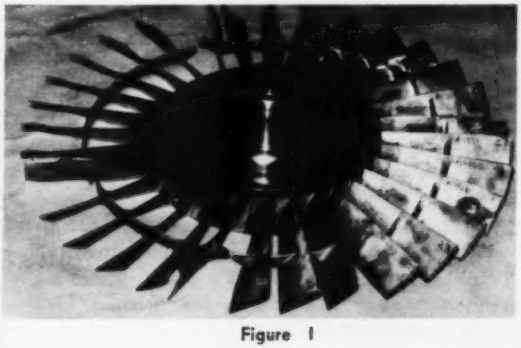


Figure 1

Okay, now what happened? How did that FOD occur and how can you avoid it? First, a brief review of pertinent facts about air. If free standing air is suddenly accelerated by the impact of a body moving through it, these air particles will be heated by the motion and experience a temperature rise. The resultant temperature is what you read on an OAT gage and is termed total temperature.

The total temperature is now a measure of total energy in the airstream. If heat is neither added nor subtracted from the air, as it flows down the inlet duct, no matter how the duct area varies, the total temperature will remain constant. The static temperature (Ts) of the air in the duct, however, is a different matter entirely. Ts will be lowest at the duct station of smallest area. This occurs within a foot or two of the inlet lip and at the compressor inlet. The smallest area and, therefore, the coldest station, is the one near the inlet lip. The drop in static temperature in the duct will be enough to cause it to fall below altitude static temperature when the duct Mach number is greater than flight Mach number. It should be noted that duct static temperature (Ts) can be calculated, but cannot be

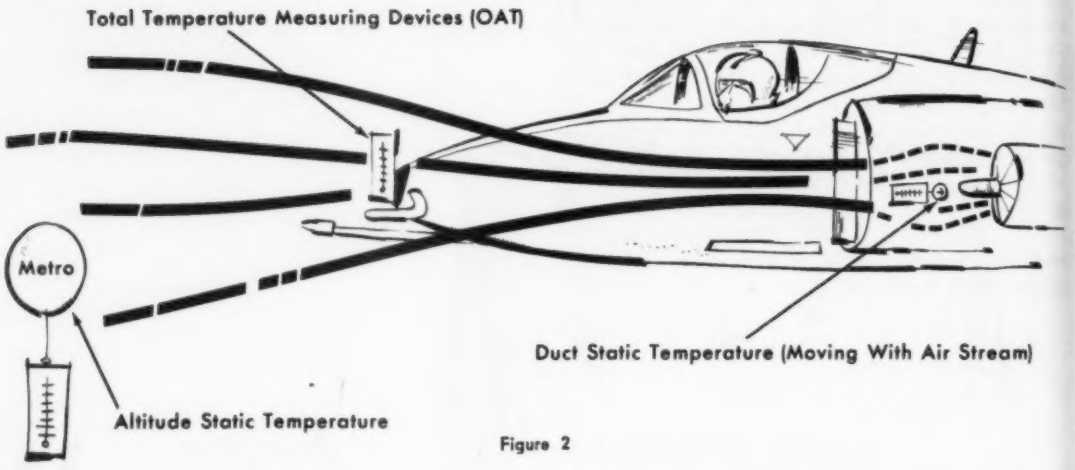

Total Temperature Measuring Devices (OAT)
Metro
Duct Static Temperature (Moving With Air Stream)
Altitude Static Temperature

Figure 2

measured. Why? Because the only way to measure it would be to have an instrument which moves along with the same direction and velocity as the airstream.

Figure 2 illustrates these three temperatures: altitude static temp, OAT, and duct static temp. The duct static temp is critical because this is the temperature that water particles approach as they are carried down the duct by the engine airstream. When duct static temperature drops below 32°F, we have a situation where liquid water in the airstream can freeze.

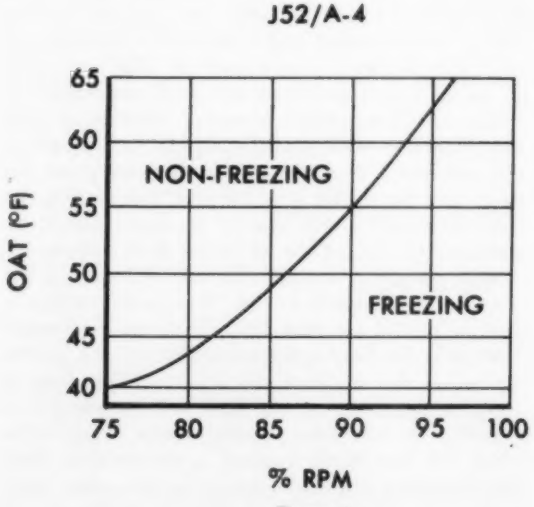


Figure 3

The combination of engine speed and OAT that defines where 32°F will be obtained at the minimum duct area is shown in Figure 3. This figure was made for the J52 engine in the A-4E aircraft. It can be used with confidence for this aircraft to stay away from warm air icing at any altitude or flight speed.

We haven't mentioned the apparent similarity between this icing phenomenon and the familiar carburetor icing in the reciprocating piston power plant because of a major difference. Carburetor icing is usually due to two factors—a drop in temperature due to the small area of the carburetor venturi and a drop in temperature due to the fuel vaporization. The drop due to the small area of the venturi is similar to the effect in a turbojet inlet. However, the turbojet doesn't experience anything similar to the fuel vaporization effect.

So far, this has all been theoretical, so how about some actual data, like photos, of ice formation at OATs well above freezing? Take a look at Figure 4. This is one frame of a high speed movie film that was taken of the compressor inlet of a J52 engine operating in a U. S. Naval Air Propulsion Test Center altitude test chamber in a simulated rainfall. OAT was 45-50°F, RPM was 92 percent. The engine had been operating in the rainfall environment for a little over one minute with the engine anti-icing system turned off. That white stuff ain't Santa's whiskers, Bud; that's ice! Not shown in the photo is a device that NAPTC used to tell when ice formation began. This was a ice detector obtained from commercial sources.

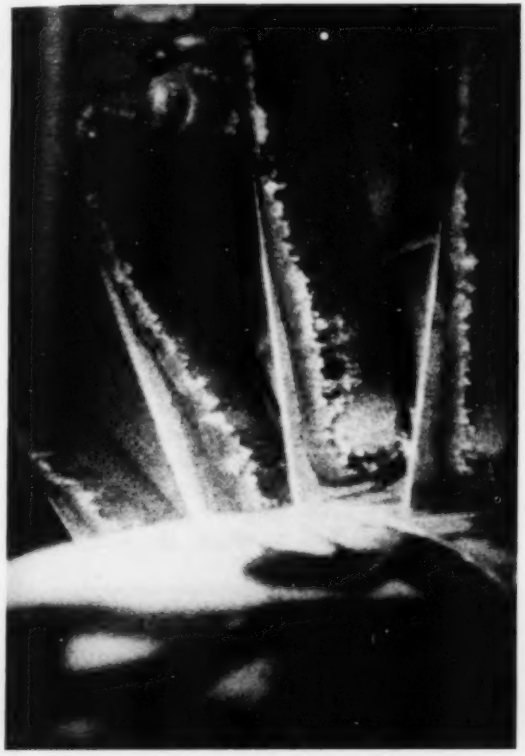


Figure 4

Further proof was obtained when inflight water ingestion tests were conducted on a TF30 engine in the A-7 aircraft. Prior to these tests, NAPTC had discussed the problem of warm air icing with the flight test personnel who were to do the TF30/A-7 testing. It should be noted that the A-7 minimum duct area exists upstream of the engine and is not anti-iced. They were given points on the OAT *vs* N_2 curve for their power plant airframe combination. They were also advised to install the ice detector at the minimum area location and that it would warn the pilot within a few seconds after the beginning of ice formation. When the water tests were actually conducted, lo and behold, the specially installed ice detector light came on whenever the RPM-OAT was below their OAT *vs* N_2 curve. When the light came on indicating ice formation, the pilot pulled out of the water stream. Using this technique, no FOD was noted. NAPTC has made the recommendation to Naval Air Systems Command that ice detectors be installed in inlet ducts as standard equipment.

Two more examples of the effect of high inlet velocities upon air temperature depression should interest you.

When the humidity is high, you don't need visible moisture to form ice. The static temperature depression in an inlet can be enough to cause the incoming air to fall below the dew point, with resultant condensation and icing if the duct static temperature is below 32°F. Well-qualified researchers in Canada investigated this problem and recommend using engine anti-icing air.

When the duct static temperature is above 32°F but below the dew point, liquid water will fall out but no ice will be formed. Reports of this phenomenon have come from Southeast Asia. After high power ground run-ups on warm humid days, operators have noted significant quantities of liquid water lying on the sides of inlet ducts, near the compressor.

Our conclusion which after analysis was verified by actual testing is that high inlet duct velocities can cause inlet icing at OATs up to 30°F above freezing. The percent RPM and OATs where this can happen may vary from one model jet aircraft to another, but the principle is the same in all cases. For the A-4 aircraft, Figure 3 is a practical guide for describing the conditions where icing can occur in the inlet. Now will you believe?

Mr. Eric Lister is an aerospace engineer at the Aeronautical Turbine Department of the Naval Air Propulsion Test Center, Trenton, N. J. He has been evaluating gas turbine power plants for the Navy since June 1959, when he was graduated from Drexel Institute of Technology with a degree in Mechanical Engineering. Mr. Lister is currently completing graduate work toward a Master's Degree in Aerospace Engineering.

AIR BREAKS

Knowledge and timber shouldn't much be used till they are seasoned.

Oliver Wendell Holmes

Check the Book

On a test flight in a UC-45J, the port propeller failed to go to full feather and despite all attempts to secure the engine, it remained on the line windmilling at 700 to 800 rpm.

The pilot informed the tower of his difficulty and since he was close to the field, received clearance for a straight-in to the duty runway. The approach was normal until electrical power failed as the pilot dropped the gear at 500′.

A positive gear indication now became quite elusive. The light in the gear handle was out and would not come on when pressed to test. The warning horn had stopped sounding also when the power failed. Since the light was out in the landing gear clutch compartment, the plane captain felt around the clutch spline with his fingers and determined that the teeth were not properly meshed, indicating that the wheels were not locked down. The pilot continued his approach and tripped the landing gear clutch while the plane captain tried to lock the wheels in position using the hand crank.

Both wheels could be seen from the cockpit, but because he was not sure of their true condition, the pilot took a waveoff at 200′. He raised the gear handle and depressed the clutch once again while the plane captain tried to crank the gear back up manually.

The crewman was unable to raise the gear all the way and the busy pilot soon found that he was unable to maintain airspeed and altitude. Past the point where he could safely land on the runway by this time, he continued across the field and out over an adjacent river bed. With the crewman still attempting to raise the gear, the pilot continued up the river until the airspeed dwindled to 60 kts and further maneuvering became impossible. Approaching a sharp bend in the river, the pilot chose the only remaining alternative and made a smooth, controlled touchdown on the water. The crew swam safely to shore and were picked up uneventfully by rescue helo.

After being salvaged from 15′ of brackish water, the aircraft was cleaned, dried out and all systems were thoroughly checked. No difficulty was encountered in free-falling the main mounts and lock-

Hazards of Formation Takeoffs

Two F-8E aircraft started rolling on an authorized section takeoff. After releasing the brakes and commencing to roll, the leader signaled for AB ignition. Both aircraft went into CRT and a few seconds later the wingman began to overtake his leader so he modulated his burner to decelerate. A second lower modulation did not help so he deselected AB. About two seconds later the wingman was again in position so he reselected the burner but it did not light and the leader pulled ahead.

Meanwhile, the leader observed the wingman to drop back so he modulated his burner back 1 percent. This did not seem to help the wingman to catch up and a moment later, the leader heard the wingman transmit an aborting signal. The leader now was faced with an instantly required go or no-go decision because of dwindling pavement. He went back to

full CRT and got safely airborne.

When the wingman's AB did not relight, he returned the throttle back to the MRT position. He had intended to make another try with the AB, but his plans were interrupted by aircraft vibrations. This coupled with the AB trouble led him to believe there might be serious engine malfunctions so he backed the throttle to idle and transmitted his abort intentions (which were heard by his leader and the tower operator).

The tower operator was on the ball as he transmitted, "(aircraft call sign) drop your hook, drop your hook, E-14."

When the abort decision was made, the *Crusader* was about halfway down an 8000′ runway indicating about 120 knots. The pilot tried to hold the nose up to get maximum aerodynamic braking but the nose wheel would not lift off. He then dropped the hook simultaneously realizing he was just passing over the pendants and would miss them. This motivated him to secure the engine and commence maximum braking. All to no avail; the F-8 ran off the end of the runway onto the gravel overrun veering to the right, blowing the starboard tire and striking an unoccupied wheels-watch cart. Sixty feet farther on, the landing gear was mangled against a large hunk of concrete. The well bent bird finally came to rest 15′ beyond the cement block and the pilot got out unharmed.

Since the leader was at maximum rated thrust, it is unfortunate that the wingman's plane seemed to have even greater power, the reduction of which, seemed to instigate this chain reaction of trouble. Probably the AB did not relight because the engine was not designed for recycling in less than five seconds. The vibration was suspected to have been the nose wheel (common to the F-8 at or near lift-off speed.)

The briefing for this flight did not include abort procedures. This combined with the pilot's paucity of *Crusader* experience was considered to be the basic cause of this accident.

ing them DOWN manually. But the maintenance crew found that the gear could not be cranked all the way UP without having someone outside pushing on the wheels. A conference with tech representatives confirmed that sufficient mechanical advantage was not built into the system to allow for full manual retraction without outside assistance.

Investigation further revealed that the pilot and plane captain had acted against one another when they tried to operate the gear manually. The pilot was unaware that the clutch pedal had to be released and the hand crank rocked back and forth to mesh the teeth after the gear had been cranked down as far as possible. Consequently, he had held the pedal in continuously, except for a few moments when he had to take his foot off the clutch to control the rudders. The plane captain, meanwhile, didn't check the position of the clutch when he found that the teeth were not engaged. The uncertainty which his report caused led the pilot to take the fateful waveoff.

If the pilot had known that the gear could not have been brought up again manually, his course of action might well have been different. For the aircraft's weight and configuration at the time, however, a waveoff was unfortunately impossible. Overhaul damage resulted.

Pertinent revisions to the flight manual have been referred to NavAirSysCom for action.

Reader QUESTIONS

Have you a question? Send it to Headmouse, U. S. Naval Aviation Safety Center, Norfolk, Virginia 23511. He'll do his best to get you and other readers the answer.

Headmouse ANSWERS

Jacket Problem

Dear Headmouse:

Nearly all of our extreme cold weather gear falls into the category of "unsafe" as described by NavSo P-2455 which states:

"2017 Accidental Ignition Causes, Petroleum Fuels

"4. Clothing. Men engaged in loading, unloading or cleaning tanks shall not wear boots or shoes with exposed nails or metal fastenings. Do not allow any buttons made of sparking metal to be exposed. Beware of key chains, belt buckles and tools in pockets.

"In *highly hazardous* areas, personnel are not permitted to wear outer or under garments made of wool, silk or synthetic textiles such as rayon and *nylon*, as these materials can generate sufficient static electricity to cause ignition of highly flammable products."

We're up an alley on this one. Any information you may have on the subject to help us out of this dilemma will be appreciated.

LCDR D. GALLEGOS, JR.
ASO, GLENVIEW

▶ According to NavSup authorities the A-2 green cotton twill jacket, insulated, intermediate cold weather (FSN series 9D 8415 753 5611) worn with A-2 trousers and cap together with long cotton underwear under cotton dungarees and work shirt, should provide adequate warmth as well as freedom from static in dry-cold weather in the Glenview area. The A-2 cap, or other equally warm headgear, and the long underwear are the most important items of the A-2 outfit for outdoor winter duty. Thermal knit all cotton underwear is also a standard stock item for wear with either the A-1 or A-2 outfit. Although the A-2 is lined with nylon fleece there is enough cotton in the outer shell, work clothing and underwear to overcome any static buildup.

The A-1 outfit is made of waterproof nylon shell and nylon lining plus a waterproofed removable liner in the jacket. It is intended primarily for sedentary occupations, such as watchstanding aboard ship, in rough wet-cold weather and at high altitudes.

As to sparking qualities of shoes, rundown heels with exposed nailheads should be avoided. Shoes should be resoled by cementing and stitching without nails. Usually work shoes are repaired with synthetic half-soles, cemented and stitched except across the back edge where they are nailed. These nails are off the ground because of the shape of the sole bottom.

There has been a general misunderstanding that brass nails do not cause sparking. According to the Navy Office of Civilian Manpower Management, cog of NavSo P-2455, metal hard enough to fracture a quartz crystal in concrete aggregate may cause sparking. This includes brass.

Very resp'y,

Headmouse

Unlike the flight control systems on present day high performance aircraft—the Naval Aviation Safety Center desires a continued feedback.

Has information in any Safety Center publication ever helped you to prevent an accident, avert an injury, or deal with an emergency in a better way?

If so, and you have not already informed the Safety Center, it is particularly desired and important that you do so. Such feedback is vital to all departments at the Center and for fiscal support of our safety research and education program.

Pilot Factor vs Pilot Error

Dear Headmouse:

I have noticed a recent trend of references to *Pilot Factor* and *Pilot Error* as though the terms were synonymous. I believe the former is a more desirable term for the following reasons: (a) While *Pilot Factor* is a more general term, it is more often correct; i.e., a pilot may be a factor without being in error. (b) The term *Pilot Error* antagonizes aviators and leaves no room for mitigating circumstances.

As safety officers, we continually fight the closed mind, closed mouth, "don't tell the ASO attitude." Weasel wording is not my specialty and certainly not my intention. I believe that Pilot Factor can be used with more accuracy in every instance. To those professionals who understand the good motives of the Safety Center, semantics doesn't matter. To those less professional cynics, the choice of a word might be just the thing I need to win their support.

LT PAUL D. BROWNE
ASO, NAS CORPUS CHRISTI, TEXAS

▶ The philosophy you promulgate is completely accurate and shared by the Safety Center, which discontinued the use of "Pilot Error" in favor of "Pilot Factor" in published statistics and closeout endorsements to AARs several

B.C. by Johnny Hart

years ago. If the term "Pilot Error" has again crept into some Safety Center documents subsequently, it is inadvertent and/or due to personnel changes. A renewed effort will be made in NavAvnSafeCen to only recognize "Pilot Factor."

Thanks for your letter. Let's hope this interchange of correspondence will result in greater accuracies.

Very resp'y,

Headmouse

Exhaust Gases

Dear Headmouse:

It cannot possibly be healthy for personnel working inside a hangar to be continually exposed to carbon monoxide given off by the F-8s on the flight line which are being highly accelerated during repair. The birds are parked with their exhausts toward the hangar. During these repairs, air is forced out of the hangar and the exhaust gases pocket within the hangar causing burning and watering of the eyes and difficulty in breathing. A simple remedy would be to park the birds with exhausts away from the hangar in their present positions except with directions reversed.

ANYMOUSE

▶ The remedy, as you say, would be to eliminate the exhaust gases by pointing the tail pipes away from the hangar. We suggest that the maintenance officer be informed for appropriate action.

Very resp'y,

Headmouse

Generator Malfunctions

Dear Headmouse:

Recently a US-2C returned from a cross-country with a d.c. generator inoperative. The failure occurred 15 minutes after takeoff. Since, however, the weather was VFR and the other generator was working satisfactorily, the pilot elected to press on with the mission. Fortunately, there were no other discrepancies and the aircraft returned home without difficulty.

My contention is that the pilot was asking for trouble by not returning to his home base immediately after discovering the generator failure. Can you give an opinion on this matter and any facts as to the number of incidents/accidents which have resulted from similar situations?

LT DON C. LEISSNER
CHULA VISTA, CALIF.

▶ Yes, we agree that unless the mission was urgent the pilot should have aborted the mission and returned to base to correct the generator trouble. Here at NavAvnSafeCen there is a record of two similar incidents of generator failure on S-2 model aircraft wherein fire developed before the aircraft were able to be returned to base. Fortunately, in both cases, the fires did not get out of hand and the aircraft were landed safely.

A search through NATOPS for the model aircraft did not reveal any instructions about aborting when one of the two generators failed. Consequently, aircrews must be trusted to make the necessary decisions according to their diagnosis of the malfunction(s), weather and mission urgency.

Very resp'y,

Headmouse

PASS IT ALONG!

Each copy of APPROACH is meant for ten readers.

SOME WEA

Reliable a O

RELY ON

HAIR

If a pitcher stays clear when filled with cold water and if hair crackles when combed, there is relatively little moisture in the air. But if the pitcher sweats and permanents go awry, humidity is high. (Hair increases in length with humidity.)

FLAGS

Follow the pointers given by trees and flags. Winds from the south and east usually (but not always) precede foul weather. Northerly winds ordinarily bring clearing skies and cool evenings. "The wind in the west suits everyone best."

CORNS

Lessening pressure, as recorded by a falling barometer, may cause some old pains to return. You may suffer from shooting corns and aching teeth.

CRICKETS

Listen for a cricket. This hopping thermometer chirps at a rate that increases as the temperature rises. In warm weather, count the number of chirps in 15 seconds, add 37, and you'll have the temperature of the air near the cricket.

EATHER SIGNS

le and Otherwise

DON'T RELY ON

BIRDS

Whether birds fly south earlier or later than usual has nothing to do with the weather to come. They may have run out of food—or perhaps have forgotten to look at the calendar.

GROUNDHOGS

When a groundhog sees his shadow at noon on February 2, it does not signify that the next six weeks will be unseasonably cold. It means only that the sun is shining at that time.

SQUIRRELS

If squirrels have plump tails in Autumn, don't count definitely on a white Christmas. A fat tail merely indicates two things: an ample summer food supply and a large appetite.

CATS

Here's an old saw you can trust. "Cats with their tails up and hair apparently electrified indicate approaching wind—or a dog."

More people would be in favor of progress if it could be accomplished without change. Anon.

Short Snorts

Landing gear can only take so much.

Hold Still, the Ship

An F-8E pilot was scheduled for CCA practice. The first approach to the carrier resulted in a bolter due to hook skip. The LSO informed the pilot that a pitching deck contributed to the bolter. Fuel state was 2600 pounds.

For the second approach the pilot followed a radar controlled bolter pattern. At the beginning of the glide slope, the *Crusader* was slightly high and then as the descent continued to about 1000′ aft, the F-8 was noted to be slightly low. The pitching deck made it difficult for the pilot to hold the "ball" (this fresnel lens only provided point stabilization). As he approached the ramp, the deck pitched up noticeably and the pilot tried to match corrections by attitude changes. This resulted in getting out of phase with the radical pitches and the touchdown on the deck was excessively hard although the plane snagged the No. 2 pendant, fortunately, on the centerline. The port MLG shock and tension struts failed allowing the port wing and ventral fin to contact the flight deck during runout. The unharmed pilot shut down the engine and the bent *Crusader* was struck below for repairs.

The carrier involved had a point stabilized lens. There is a modification program underway to convert all fresnel lenses to line stabilization. This should virtually eliminate meatball movements under pitching deck condition and thereby minimize accidents of this type. Meanwhile, it is imperative that pilots understand the effects of ship's deck movements on lens presentations according to the type of stabilization.

Engines to Play With

A P-3A was cruising along at 800′ on an ASW patrol. Number 1 engine was feathered for SOP loiter. Suddenly, the chip light on No. 4 engine momen-

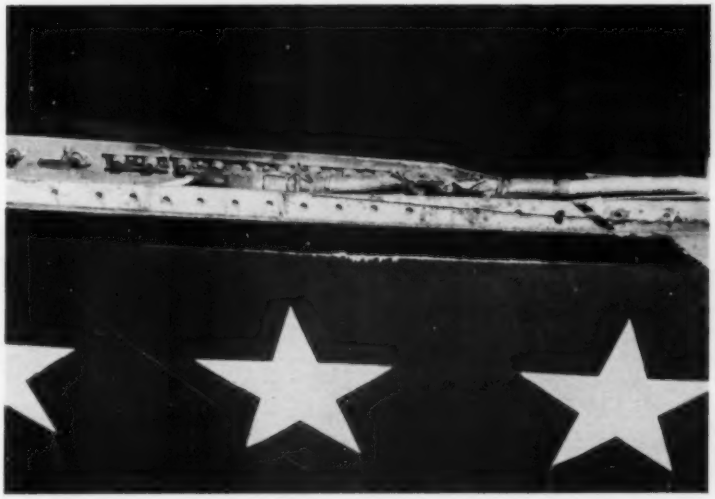
tarily illuminated simultaneously with an observed loss of shaft horsepower. All other engine gages continued to show normal indications so it was decided to make no immediate changes. Five minutes later the No. 4 engine chip light came ON steady accompanied by a low oil pressure light. At the same time, a groaning sound was heard from the area of the engine. This prompted an immediate securing of No. 4 engine with the E handle. Engine power levers for 2 and 3 were advanced to maximum power and No. 1 engine restarted.

Meanwhile the ailing engine had stopped rotating and then started to slowly turn backwards. This new condition now required further special attention. Oil pressure was restored by chopping the fuel and ignition, pushing the E handle back in and pulling the oil shutoff circuit breaker. The propeller was unfeathered and when it stopped the backwards rotation, the feather motor circuit breaker was pulled. This did the trick until the landing approach; then the propeller started slowly rotating again. Nevertheless, a safe landing was accomplished.

Postflight investigation revealed that the propeller had decoupled from the No. 4 engine. The torquemeter shaft shroud in the area of the flange mounting to the gearbox showed evidence of burning which was caused by extreme friction.

The Cable Walker

Some F-8Es were conducting scheduled Sidewinder practice runs on a towed Hayes target. Radar contact was intermittent so the flight leader decided to make a visual inspection. He made a close formation join-up on the towplane and then eased off throttle to slide back along the length of the tow cable. Somewhere in the neighborhood of the cable end, the pilot lost sight of the very thin line. He aborted the search, rejoined the tractor aircraft and monitored the reeling in of the deployed line. The mission was cancelled because the target was missing.



A whipping cable has cutting power.

The next day maintenance personnel were working off a UHF gripe written by the *Crusader* formation flight leader. Damage to the vertical stabilizer which housed the antenna was then discovered. A recapitulation of events concluded that the damage was inflicted by the tow cable, unknown to the pilot at the time. The whipping cable near the end (having lost its target) lashed the stabilizer about the time the pilot had lost sight of it.

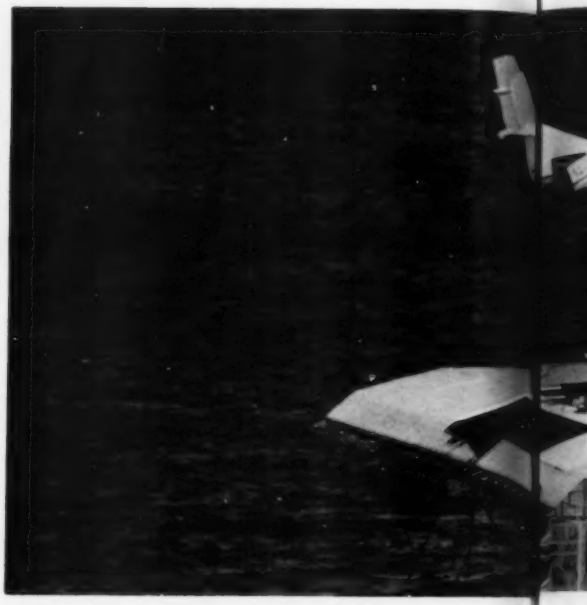
This is an unusual type of incident but it does demonstrate just how difficult it is to see a tow cable streaming out behind a tractor plane. Such exercises should always have a guard plane accompanying the tow plane to ward off other aircraft. At the same time, the guard plane must not let himself lose sight of and/or drift into the tow cable.

Simulated Instrument Takeoff

During a simulated instrument takeoff, a student pilot was given control of the TF-9J at 80 kts. Upon assuming control, the student allowed the aircraft to drift to the right. The instructor quickly called for corrective action but there was no response. After two more quick warnings went unheeded, the instructor took control. By this time the *Cougar* was indicating 125 kts angling very close to the edge of the runway. It was too late for a normal takeoff because the airplane left the runway and its right flap hit the top of the 3000′ marker as it staggered airborne.

Once safely in the air, a pilot in another aircraft flew close formation on the slightly damaged TF-9J and told the instructor that the underside of the flap appeared to be only slightly damaged. After slow flight checks were made, a routine landing was accomplished.

Instructor pilots must be alert and ready to take control of the aircraft on the slightest indication that the hooded takeoff is developing into a dangerous situation.



Flight Training and Human Factors

By Robert A. Alkov, Ph.D.
Human Factors Division
Aero-Medical Department
NAVAVNSAFECEN

The training that naval aviators receive is the finest and safest in the world. In order to remain so, the flight training program must be continually updated to cope with the growing demands of fleet commitments and the development of advanced aviation systems. Innovations in tactics and equipment in the fleet require maximum flexibility from flight training programs. While building upon the lessons of the past, a continual battle must be fought to prevent formulas that have been successful in training from becoming dogma and from being applied long after they have ceased to be useful.

Today, human factors scientists are applying the findings of research in human learning and behavior to every phase of human endeavor. An objective analysis of the flight training situation in the light

The end product of naval aviation flight training is the designated naval aviator.

of such findings may reveal problem areas that have been overlooked before. This article will attempt to examine the flight training process in order to define the tasks that are involved and the skills that are needed to handle such tasks.

The end product of naval air training is the designated naval aviator. His is the most exacting role in all of aviation—that of landing a modern jet aircraft aboard an aircraft carrier. The training process for such a role requires the acquisition of a number of skills. These skills may be sorted into three categories; perceptual skills (information gathering), cognitive skills (information processing) and motor skills (muscular responses).

Perceptual Skills

The perceptual channels that are heavily utilized in flight are those of vision and audition. Aircraft instrumentation places a heavy burden on the visual channel and engineers are increasingly using auditory signals to replace some of these. A pilot utilizes his tactual channel when he responds to control pressures. In addition, tactual channels are being studied as receptors for other flight information.

The stick shaker utilizes this channel to signal the pilot that his airspeed is getting close to stall speed in some aircraft. Methods of extending the pilot's perceptual range include radar, sonar and radio.

To any learning situation a person brings what psychologists term expectancies or perceptual sets. These expectancies are based upon past experiences with similar situations. Through training, the student acquires new perceptual sets which form the basis for the detection and correction of errors.

Perceptions are affected by many things in addition to prior experiences. Some of the things which influence perceptions are emotion, physiological condition, motivation, education and cultural background. Fatigue, boredom, apprehension and frus-

Each student is an individual and must be handled on an individual basis.

tration are all capable of causing perceptual distortions. In spite of the reduction in individual differences brought about by the Navy's flight trainee selection process, each student is an individual and must be handled on this basis.

Motor Skills

In flight, the fledgling aviator is flooded with unfamiliar stimuli which must be sorted out and responded to without delay. He finds himself in a strange and hostile environment where an error could cost him his life. Also, since his performance is being constantly monitored by an instructor, he feels the pressures of striving to achieve good flight grades.

At first, all of the student's responses may be inappropriate and a large number of errors may result. He may feel anxious because of his lack of control over his environment and may lose self-confidence. His thought processes cannot keep up with the rapidly changing situation and the overwhelming number of tasks that must be handled within a short span. His anxiety brings about certain physiological changes in his body. His heart rate increases, his blood pressure rises, his skin becomes clammy and his mouth becomes dry. His perceptual and motor channels may become disrupted.

Under these circumstances a calm word from an understanding instructor may bring him through the crisis and allow him to gain control of the situation. Such confidence-building will create a foundation for his future handling of emergency situations. On the other hand, an excited or angry voice on the intercom at such times may do irreparable damage to a flight student's self-confidence.

As control is gained over the machine, the student begins to feel that the aircraft's control systems are an extension of his own arms and legs. The direction and magnitude of his control inputs become attenuated through practice. The integration of man and machine is complete. The psycho-motor skills that have been acquired through the trial and error process become automatic, almost reflexive and thought channels are no longer tied up to accomplish such tasks as maintaining straight and level flight. Perceptual/motor tasks can be learned so well that several such tasks can be performed simultaneously with cognitive tasks.

Cognitive Skills

Cognitive tasks, on the other hand, cannot be performed concurrently with each other. For example. decision making, evaluation and interpretation of information are processes that require thought and must be handled one at a time. It is the speed of transition from one cognitive task to another which enables an aviator to handle a large amount of information in one time frame.

Stress and anxiety arising from an emergency situation can block cognitive processes. Here, thorough knowledge of emergency procedures, of aircraft systems and of his own capabilities can allay such anxiety and enable the experienced aviator to handle emergencies in a professional manner.

Time Sharing

In flight there are a number of tasks which must

be performed simultaneously. This is known as *time sharing*. These tasks may be classified as continuous tasks (maintenance of flight attitude, for example); discrete tasks (discontinuous tasks made up of separate items); communications procedures; systems monitoring tasks (aircraft and engine performance and cockpit environment, etc.) and data processing and computation (navigation, mission tactics, etc.). Such tasks demand the utilization of all of a pilot's performance channels (visual, auditory, tactual, cognitive, motor, etc.) in an extremely restricted time frame. The process of flight training involves the integration of all of these tasks into a single time frame.

Continuous Tasks

An example of a *continuous task* is the maintenance of straight and level flight. Such a continuous interaction between pilot and aircraft is called a closed loop system. This is because information about the aircraft's position in space relative to the earth is relayed to the pilot through his instruments cueing him to make inputs into the system which are then reflected in a change in the instrument display. In other words, the pilot's response on the controls changes the stimulus situation, which in turn, cues the pilot for his next response.

The instructor's calm attitude is important.

Such tasks as these employ the psycho-motor system of the pilot and, as stated before, they become automatic through learning and do not require any conscious effort on the part of the pilot. As such they are considered to be semi-skilled tasks.

Discrete Tasks

Discrete tasks include control subtasks that may occur only once or twice in a flight such as the operation of landing gear, flaps, speed brakes, afterburner, etc. That is, the pilot moves a control which changes the aircraft's status and this information is relayed to the pilot. The chain stops there unless the pilot wishes to change the aircraft back to its original status.

Routine subtasks of a discrete nature although considered to be semi-skilled are more difficult to learn and retain than are continuous subtasks. They make demands on perceptual, cognitive and motor skills. Once learned, these routine tasks become habitual. When a chain of discrete subtasks is broken by a sudden change in the stimulus pattern confronting the pilot, items are frequently omitted. The pattern of discrete subtasks may be resumed at a point ahead of the interruption and consequently several items may be left out. Thus the landing gear may be forgotten when the landing check list is interrupted by a transmission from the tower. This is why it is important to go back several items on a check list when an interruption occurs.

Communications Procedures

Another task which demands some cognitive effort as well as perceptual-motor skills is that of communications. This task can be quite distracting to a pilot when his other cognitive channels are being utilized. A recent accident occurred in which a pilot on an IFR plan who had relatively little actual instrument experience was distracted on takeoff by a transmission from the tower. At the point at which he was the busiest, cleaning up the gear, trimming the aircraft, etc., he entered a low ceiling over the runway. The tower called at this point to direct him to contact air traffic control on a certain frequency. A moment later the aircraft crashed in the woods at the end of the runway. Presumably the pilot was absorbed in tuning radios at this critical point and was momentarily distracted from his task of flying the aircraft. This transmission could have been made prior to takeoff. At such critical points during takeoff and transition to instruments, a pilot's efforts must be directed to flying the aircraft.

Data Processing and Computation

Subtasks that require data processing and computation on the part of the pilot include such problems as ASW tactics, target identification, navigation, etc., which require a certain amount of knowledge and thought. These tasks can be distracting to the maintenance of flight path under marginal conditions when a continual scan of the instruments must be maintained. These subtasks require the highest skill level of all and are especially demanding upon

the cognitive skills of the pilot. They require a great deal of training and practice.

Systems Monitoring

In addition to these subtasks, a pilot's time must be devoted to *systems monitoring* of aircraft and powerplant performance and the maintenance of cockpit environment. Some systems monitoring tasks such as fuel management are considered to require a high level of skill and are highly demanding of a pilot's perceptual and cognitive channels. The difficulty of the perceptual tasks required is directly related to the design and layout of flight and engine instruments and cockpit environmental controls. It is the responsibility of human factors engineers to point out ways in which these perceptual tasks may be simplified through the grouping and redesign of such instruments and controls.

Engine instruments may require only an occasional scan whereas flight instruments must be scanned continually, especially in instrument flight. In addition, during VFR flight the pilot's perceptual subtasks include a continuous outside scan for other aircraft and the sighting of landmarks, targets, etc. The monitoring of cockpit environment requires only a small percentage of a pilot's time in adjusting oxygen, heating, cabin pressurization, etc. but this must be considered in the overall time demand made upon the aviator.

It is evident that in flight a large number of tasks must be performed concurrently within the same time frame. In high speed aircraft the time factor becomes critical. The tolerance for error is lessened. This is especially true when the phase of flight involves a carrier landing where precise altitudes, airspeeds and lineups must be maintained. In an emergency, the time demands made upon the pilot may exceed the capability of the human organism to perform them. Thus an accident may result. Human factors engineers should evaluate all such systems in the preliminary stages of design in order to insure that such critical time demands do not occur.

Principles of Learning

Proficiency in all of these skills is gained primarily through practice. In order to be successful, training must involve gradual increases in the level of difficulty of tasks and at the same time, more diverse skills must be introduced. However, the level of difficulty must not increase at a rate that is faster than the student can handle. On the other hand, if the difficulty level proceeds too slowly, the student is not challenged and loses interest in the task. The retention span for complex perceptual/motor tasks (such as carrier landings) is relatively short, but may be strengthened by refresher training at intervals.

As the new pilot acquires the psycho-motor skills necessary for safe flight, he frees his overloaded brain for such tasks as decision making. Where initially he could handle only one perceptual task at a time, he now begins to develop an integrated scan which affords him an overall impression of the aircraft's status. Unfortunately, in arriving at this level through the process of trial and error, a large number of errors are made. This tends to discourage students in the initial phase of flight training. A primary factor in the motivation of a pilot is the satisfaction of gaining control and mastering an aircraft. Too often, students lose self-confidence through feelings of inadequacy over their lack of control of an aircraft. An instructor who is always on the controls, who will not relinquish control to a student, may cause that student to give up and depend upon the instructor to extricate him from dangerous situations.

The most ideal learning situation is one in which the student is allowed to make mistakes and correct them himself. This is the principle of "active responding." The student should set his own pace for learning and should get immediate feedback from his errors. People learn best when learning proceeds in small, easy-to-take steps, when errors are kept at a minimum and when the learning process is enjoyable. These are the principles employed in programmed learning.

Flight Simulation and Transfer of Training

The instructor's role should be as unobtrusive as possible in the initial stages of training. Such an

Dr. R. A. Alkov was commissioned and designated a naval aviator in the Naval Reserve in 1955. After a tour of duty with VS-36 in Norfolk, he was released to inactive duty and entered the University of Florida in 1957. In 1965 he received his Ph.D. in experimental psychology from the graduate school of Florida State University. After a year's experience with the George Washington University Human Resources Research Office under contract to the U. S. Army at Fort Rucker, Ala., he assumed his present position at the Safety Center. Dr. Alkov is a commercial pilot and holds the rank of lieutenant commander in the "Weekend Warriors" at NARTU Norfolk.

objective may be safely obtained through flight simulation. The requirement of 100 percent realism in flight simulators, while high in face validity, is not only unnecessary but is prohibitively expensive. The effectiveness of simulators depends upon the amount of transfer to the actual flight environment which is possible. Responses that are learned in one stimulus setting may be transferred to similar stimulus settings. However, when a new set of responses must be made to a previously learned stimulus situation, the resultant high incidence of errors may be said to be due to negative transfer of training. Aircraft designers must keep this in mind when designing control systems for new aircraft. If a control or switch in the new aircraft is located in a position normally occupied by some other control or switch, the chances for inadvertent actuation of the wrong switch or control are increased.

In Conclusion

Flight instructors and others who are responsible for the training of naval aviators should be familiar with the basic principles of learning and human behavior. A proof of any flight training course is the manner in which the graduate handles stressful situations in flight. Emergency procedures must become second nature to a pilot. The goal of all such training programs in the Navy should be the production of pilots who may be called upon time and again to test the limits of their capabilities and those of their aircraft in order to professionally carry out fleet commitments and to return safely to fly another day.

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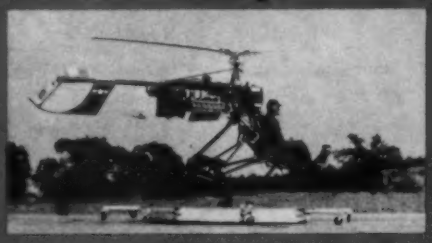
Programmed Learning In Flight Training

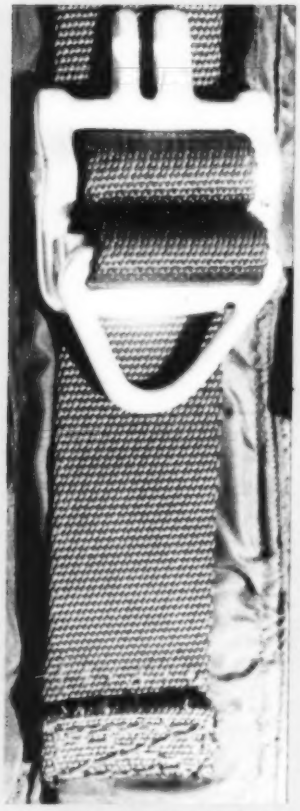


A unique method of applying the principles of programmed learning to flight training was explored by a group of scientists with the George Washington University Human Resources Research Office under contract to the U. S. Army. A small single seat rotary wing device called a whirlymite was tethered to a ground effects platform in such a way that it was free to hover a couple of feet off the platform but could not take off. (See photo.) The platform was too heavy for the device to lift but offered no friction for horizontal travel since it rode on a cushion of air. Stops were affixed to the machine so that critical angles in the roll, yaw and pitch axes could not be exceeded. A group of students of an Army indoctrination course who had not yet received any preflight training were used as test subjects.

Placed in the device with a minimum of verbal instructions, the students were allowed to operate the machine without an instructor. Although research personnel observed and recorded responses, the students were not graded for the record.

At first the platform was tied to the ground but as the students mastered the device, the tie-downs were removed to allow complete freedom of movement in the horizontal plane. Through trial and error the students learned to hover a rotary wing craft in complete safety and with a great deal of enjoyment. Later on they took less time to solo and significantly fewer of them were eliminated from flight training due to flying deficiencies after as few as 3¼ hours total practice on the device. They had developed self-confidence and a measure of control over a rotary wing aircraft before they became involved with instructors, flight grades, check rides and similar distractions to learning.

notes
from your flight surgeon



Helo Hoist D-Ring

IN several combat zone helicopter rescues in which there was no rescue seat or horse collar, the survivor has been hoisted by attaching the helo cable hook to the torso harness lift ring. Both SAR crewmen and survivors alike considered this method very effective. In one instance, the rescued pilot was unfamiliar with this method of hoist and snapped the cable hook around the left shoulder strap of his torso harness. He was successfully hoisted aboard.

Clothing and Survival Equipment Change 4: Helicopter Lift Ring on MA-1, MA-2 and MA-2P Parachute Harness; installation of refers. *Parachute Release and Rescue* (MN-10125, color, 16 min.) includes a sequence of the lift ring in use.

Kudos

"I HAVE nothing but praise and admiration for the entire helo crew. They were smooth and because of ease of rescue, I'm sure that they knew exactly what they were doing. I especially appreciate the aircrewman coming into the water for me although at the time I really didn't consider it necessary."

—Rescued pilot

Universal Problem

VERTIGO in aviation is a universally experienced problem. Here, reprinted with the permission of the editor of the Royal Navy Flight Safety Center's safety magazine *Cockpit,* Second Quarter, 1966, is an excerpt from an article by Surgeon Commander J. F. Ryan, M.B., B.Ch., titled "Lost in Space."

"Knowledge that the condition exists and its recognition are the most potent weapons against disorientation.

• Concentrate on instruments during IFR conditions. Guard against daydreaming. Avoid sudden maneuvers unless absolutely necessary.

• Cross-check and believe your instruments. One may fail but it is unlikely many will and instruments are more reliable than bodily sensation.

• Be especially careful during transition periods from light to darkness and from visual to instruments.

• Avoid fascination with one portion of your task to the extent that you put your bomb smack into the middle of the target and then fly your aircraft into the ground.

• Get yourself physically fit before you fly and you will be less likely to suffer from vertigo or fatigue leading to carelessness and subsequent disorientation.

• Keep in constant instrument practice."

Failure to Signal

AFTER post midair ejection and parachute descent, the pilots did not use personal survival equipment, investigators learned, because of daylight, good visibility and the availability of aid from local people adjacent to the landing areas. The rescue helicopter pilot, however, stated that he had difficulty locating the survivors. Use of the day-smoke signals in the survival kits would have helped SAR personnel sight the pilots promptly.

Good Thing

"I TOLD the helo pilot that the survivor was clear of the water," a SAR helicopter crewman states in a combat Rescue Report. "At this time I lost my ICS. I was having difficulty hanging out the hatch and staying hooked up on ICS. I tried to tell the pilot again

but n[illegible] set was dead. I threw someth[illegible]g at the second crewman and go[illegible] his attention. I waved my hand f[illegible]rward and told him to go tell th[illegible] pilot we had the survivor. In doi[illegible]g this I had to take one hand [illegible]ff the cable and the survivor was swinging pretty good when he got up to the aircraft. He banged his head on the bottom of the aircraft and on the starboard sponson. *Good thing he still had on his hard hat.*"

Good News

"I RETAINED my new Nomex gloves during the entire ejection-rescue evolution and found that I was able to do everything that was necessary with no impediment whatever."

—F-4B pilot

Hooked

A PILOT who ejected was successfully rescued but the SAR helo crew had difficulty separating him from the rescue seat. His seat pan which he had not released had slipped under the seat's prongs.

In this instance there was no real trouble. However, if one of the helo crew, in pulling the survivor aboard, had accidentally grabbed the seat pan handle and actuated it, the survivor's raft and survival goodies would have dropped out on lanyards, endangering the helo's rotor blades.

Minus Equipment

A HELICOPTER on a SAR mission in the mountains crashed into a small lake at 2130. All four persons aboard escaped from the submerged cabin. The two passengers were materially assisted in their exit by the landing lights which outlined the escape hatches under water.

None of the men had life vests; all swam ashore in 38°F water. They were also without survival and signaling equipment. The pilot had lost his PSK-2 kit in the water and the others had had none to start with. They tried unsuccessfully to light a fire with a cigarette lighter and a wet book of paper matches. Protected from the wind by a clump of trees, they spent the night huddled together for warmth.

When the sun came out the next morning the survivors put their wet flight suits out to dry, waving them whenever search aircraft were in the vicinity. This finally attracted attention and they were picked up by an Air Force helicopter.

Opener

DIFFICULTY in opening the survival pack was reported by an AF-9J pilot who ejected over land. "A cable had to be pulled through eyelets and the zipper was difficult to open," he said.

The pilot's trouble was probably due to his unfamiliarity with opening procedures, the squadron aviation equipment officer stated. To open the survival kit, a pull on the D-ring removes the lanyard. Removing the lanyard leaves the pack fully open. The "zipper" mentioned in the pilot's statement is a cover for the lanyard and does not need to be opened as pulling the D-ring opens the kit completely.

"They forgot the salt."

Visor Value

DURING routine flight, the center windshield panel of an SH-3A shattered, spraying fragments over the interior of the cockpit. One fragment struck the pilot's cheek and inflicted a half-inch cut. The sudden increase in air pressure caused the cargo hatch window to blow out.

The helo landed without further incident. No foreign objects were noted before the windshield shattered and there was no evidence to indicate that it had been struck by an external object.

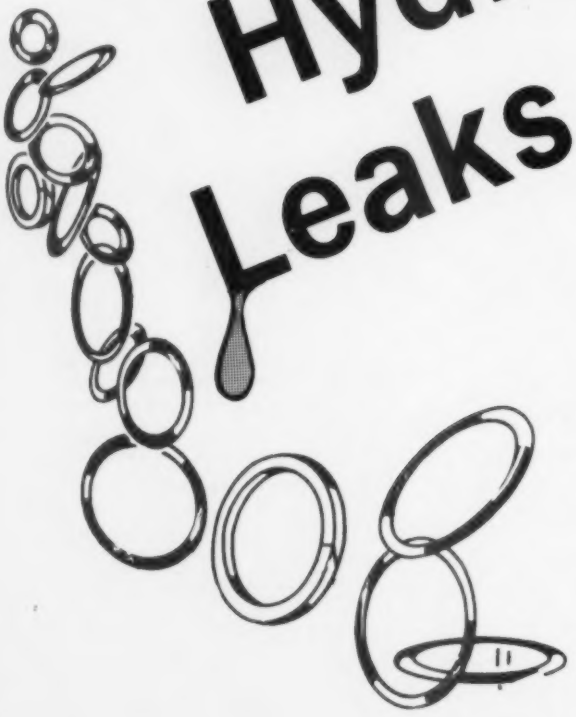
The injured pilot was wearing his helmet visor down at the time of windshield failure. This incident, the squadron CO noted in his report, serves to emphasize the value of the visor as eye protection.

Welcoming Committee

ON their return from a flight, the crew of an SP-2E was met at the aircraft and advised to select items they would take under an actual survival situation. They were taken out to a pre-selected site to spend the night. The air intelligence officer, flight training officer and VP program manager coordinated and accomplished this well received and necessary training program. Other crews will be selected at random in the future.

—NAS Memphis Safety Council

Causes and Cures for Hydraulic Leaks



Three types of relatively poor maintenance practices tend to keep the hydraulic leak problem fluid. These are:

1. The addition of fluid to the hydraulic reservoir with no attention given as to where the fluid went in the first place, and no downtime information to maintenance control as to the possibility of a hydraulic leak.

2. The tightening of a B-nut to stop a leak when we know historically, that this practice in most cases causes a leak to become progressively worse.

3. Installation of O-rings, using either improper tooling or an ill-fitting seal.

All three situations can be corrected with knowledge of the problems and application of the proper procedures.

Hydraulic Fluid

Only one type of fluid is used in naval aircraft hydraulic systems; Mil-H-5606 and it can be readily identified by its red color. Buna N compound O-rings are used with Mil-H-5606 fluid.

O-Rings

The Importance of Shore Hardness—The hardness of the O-ring plays an extremely important part in the overall service life of the seal. This hardness is referred to as the Durometer or Shore Hardness. The lower the number is, the softer the seal is.

Most O-rings used in hydraulic systems have a Shore Hardness of 70 or 90. However, for certain special applications, Shore Hardnesses as low as 60 are used.

The difference between these hardness readings is very small and extremely difficult to detect by feel alone. This is another reason why it is so important to keep the O-ring properly packaged and

identified by part number.

The following example will give one an idea of what happens if the wrong hardness is used for a specific application.

Assuming:

- A Shore Hardness of 60.
- A cross-sectional seal diameter equal to .070".
- An operating pressure of 3000 to 3500 psig.
- A diametral clearance between piston and cylinder equal to .002".

Under these conditions, the seal would completely extrude through the .002" clearance almost instantaneously. However, with a Shore Hardness of 90, the seal would work quite well and would not extrude.

Soft elastomer seals will extrude through very small clearances when subjected to 3000 psig operating pressures.

Correct Identification and Packaging—The one and only way to identify an O-ring seal is by a part number.

At the time the seal is installed (not before), the O-ring seal selected must come out of a package with the part number and cure date marked on the package. Unless this policy is adhered to, it is impossible to be sure that the correct seal has been selected.

Packaging of each O-ring separately is recommended. However, due to certain buying policies, seals are packaged sometimes as many as 10 in a package.

The greater the number of seals in each package, the greater the exposure to incorrect identification. Once the package has been opened, it is difficult to make sure the remaining seals will stay in their proper package.

Color Coding—Each O-ring manufacturer has certain identifying codes; consequently, the various combinations of dots and dashes of different colors are extremely numerous, and they should not be depended upon to determine a correct part number.

- In some cases the colors are not true and can be misinterpreted.
- On small seals, because of space limitations, a "dash" of specific color can easily be mistaken for a "dot."

Re-Use of O-Rings—An O-ring seal once used should never be re-used, regardless of how good its condition appears to be visually.

The ability of an O-ring seal to perform a second time is not acceptable either in theory or actual practice. Although it may not fail immediately, its total life will be impaired.

In most cases after a seal has been used:

- The elastomer material will take a permanent set.
- The O-ring will swell a little due to fluid contact, or may have minor abrasions or cuts not readily discernible by visual inspection.

Installation Do's and Don'ts—Once the proper part number has been confirmed, there are certain do's and don'ts to ensure that the O-ring is properly positioned and installed:

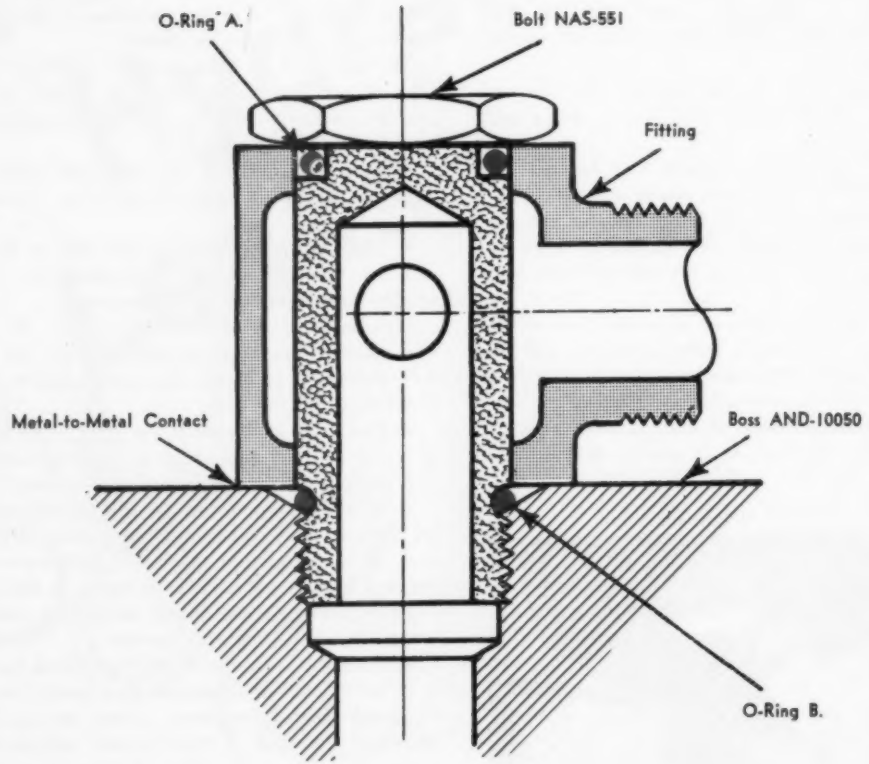
- Check the seal installation area to be sure that it is free of dirt and chips as well as nicks, dents and gouges which will impair the sealing function.
- Next in importance to cleanliness is proper lubrication. Use Mil-H-5606 hydraulic fluid (mineral oil or petrolatum vaseline). Lubrication allows the seal to slide smoothly over parts. It also permits compression of O-rings when assembling parts without tearing the surface of the seal.
- Once the O-ring is in position, check to see that it is not twisted or damaged. If it cannot be rotated by simple finger movement, it may be too tight and therefore too small. A loose fit may indicate that the ring is too large. In either of these cases, recheck the part number to assure that it is correct.

Note: During installation, rubber elastomer O-rings may not be stretched to more than a 50 percent increase in their internal diameter. *Stretch limitations must be observed.* When an O-ring is stretched, allow enough time for it to cold flow to its original shape before proceeding with the installation.

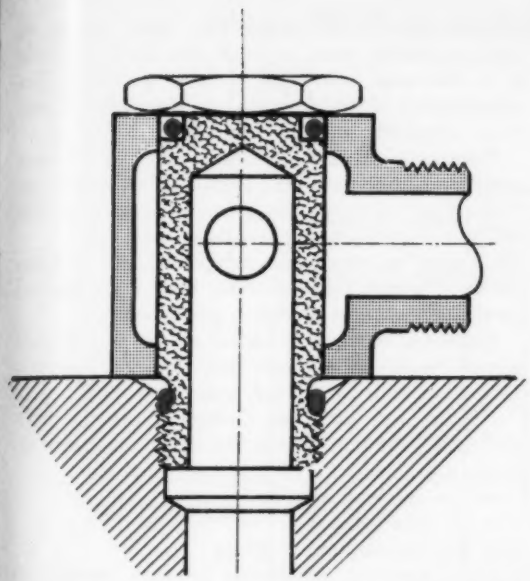
Tools to Assist in the Installation—One of the easiest ways to damage an O-ring seal during its installation is to slide it into position over threads

Loss of fluid?—Where did it go?

Banjo Fitting Installation (NAS Type)

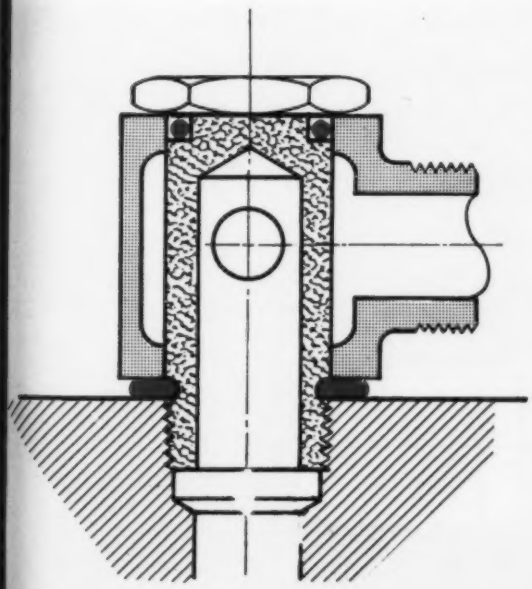


O-Ring Seals for Non-positioning Type Fittings



O-ring seal caught in bolt threads during installation results in leakage.

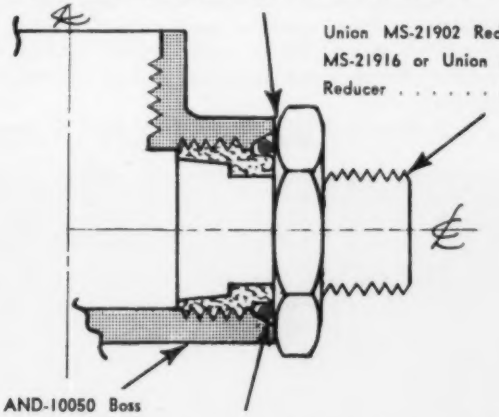
Incorrect



Oversize O-ring results in no metal-to-metal contact and fitting will leak.

Incorrect

Metal-to-Metal Contact Essential To Provide a Good Seal



O-Ring Properly Seated and Squeezed to Assure a Good Seal

Correct

Continued

or sharp grooves.

Sometimes the threads are nicked and a cut will result right across the cross-sectional periphery of the seal. On other occasions, the mere rubbing action across sharp threads will damage the seal. It must be remembered that any knicks or imperfections on the cross-sectional surface of the O-ring will cause leaks.

Tools are available to avoid this type of damage. This tool is available in sizes from —2 (1/8) to —32 (2.0″), or the complete set of different sizes can be obtained as a kit under FSN 9Q-5120-937-7428, Contract No. GS-00S-68629 (*Sept 67 Approach has details.—Ed.*)

Guide Lines for Proper Storage—The proper storage of O-rings is extremely important and there are certain rules to be observed:

- Ambient temperatures must not exceed 120°F (49°C).
- Seals must be packaged and sealed (should not be exposed to the ambient air.)
- Seals should not be exposed to light, especially sunlight.
- Seals should not be stored in the vicinity of rotating electrical machinery (should be at least 10′ distant).
- Seals should be protected from fluid drippage.

Practices such as hanging open stock O-rings on hooks or storing them in small bins similar to nails in a hardware store can lead to problems. The identification is left in doubt, the cleanliness is seriously impaired, and the cure date is unknown.

Transportation—Care should be taken in the transportation of packaged seals from storage to the user. The seal can be very easily damaged if heavy objects are placed on top of the individual packages.

Although to many this may sound like common sense, in numerous cases seals have been received by the user crushed or with a permanent set.

Particular emphasis is needed on the part of those people concerned to ensure that the small packages containing seals be treated with great care.

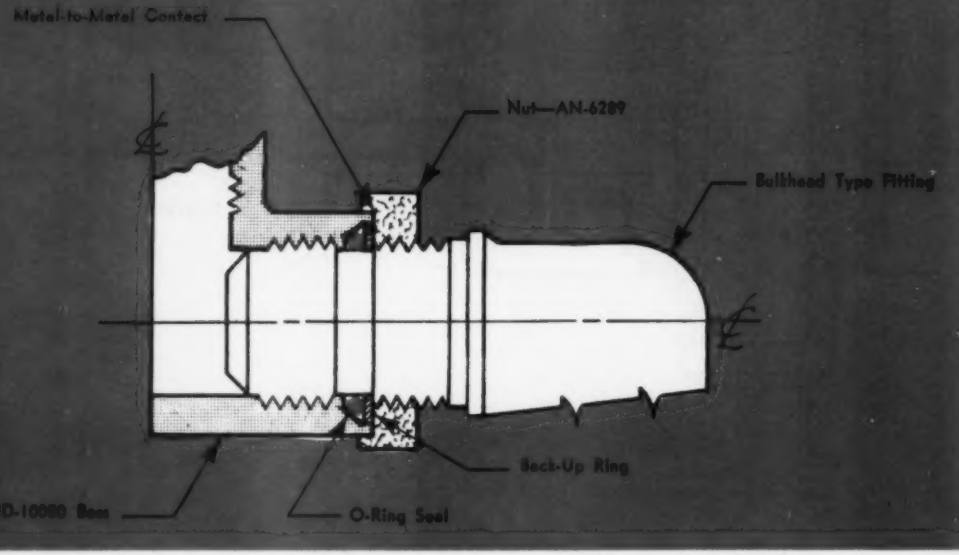
O-Ring Seals for Tube Fittings—Most of the O-ring seal leakage problems are those which are directly associated with tube fittings, such as:

- The universal bulkhead fitting
- The banjo fitting
- The nonpositioning fitting

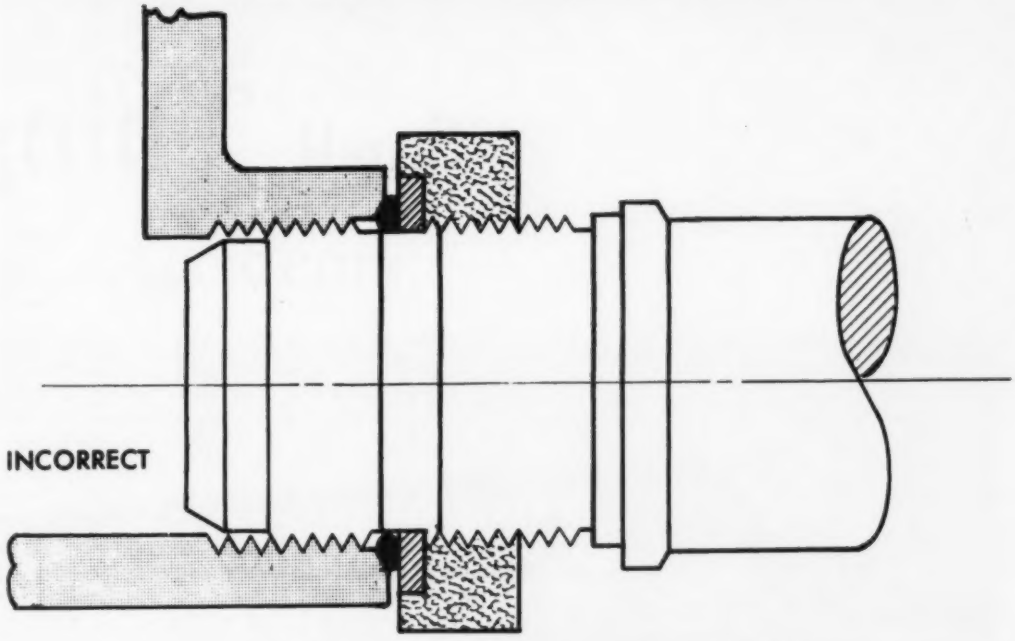
These graphic illustrations are an attempt to provide helpful information with regard to the use of O-rings for these fittings.

—Adapted from American Airlines "Maintenance Newsletter"

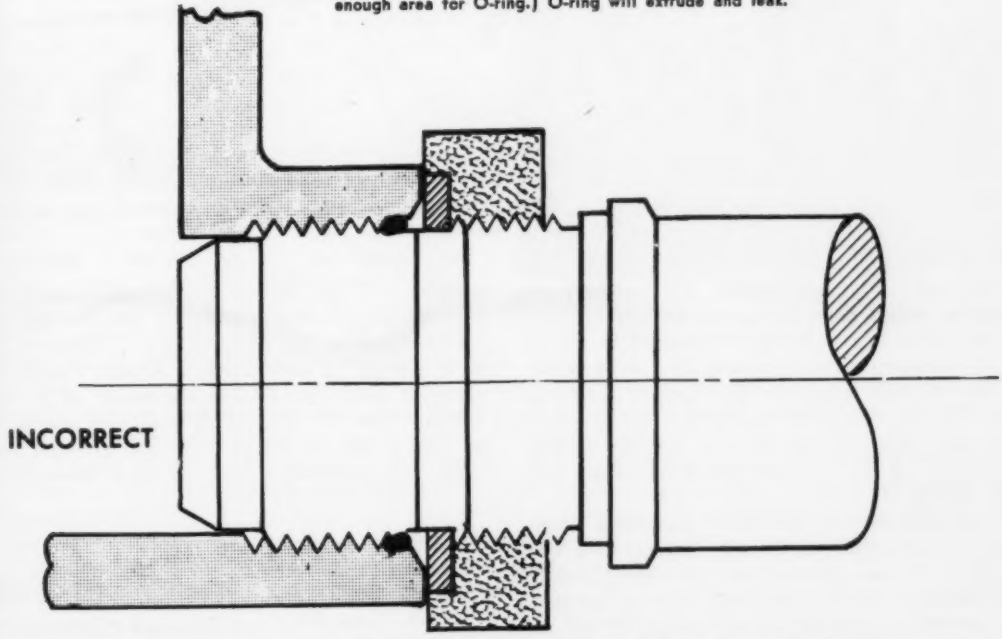
O-Ring Seals for Bulkhead Fitting Installations



Ways NOT to Install a Bulkhead Fitting

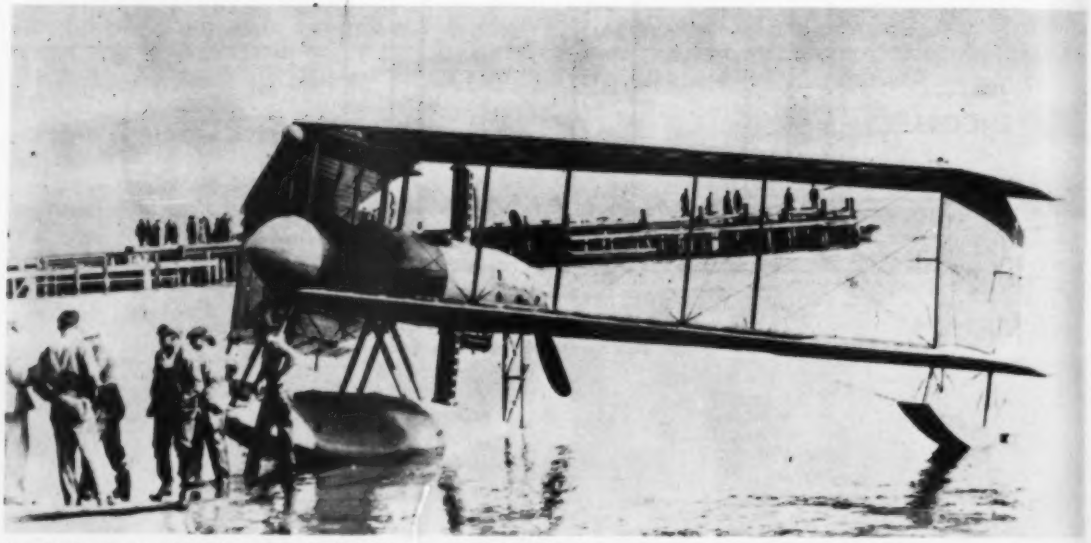


Bulkhead fitting not screwed far enough in. (Not leaving enough area for O-ring.) O-ring will extrude and leak.



Bulkhead fitting installed too far in, O-ring is cut and caught in thread. This installation will leak in service.

Small Things and



Sweptback wings, which characterize today's high speed aircraft, first appeared on the Navy's Burgess-Dunne seaplane in 1913. Shown here is the 1916 model.

In the early days of aviation the problems of aviation safety were predominantly aerodynamic and structural. Early designers knew little about aircraft structures or aerodynamics by today's standards. The aircraft frequently were fragile and often highly unpredictable aerodynamically. For the first few decades most problems of safety revolved around or centered on the structure or aerodynamic and flutter characteristics.

As we gained more and more knowledge about structures and aerodynamics they became less and less major factors affecting or influencing overall safety of flight. Serious structural failures are now rare, and tricky airplanes almost unheard of. We are now in an era wherein flight safety becomes largely a matter of little things.

Along with our impressive progress in safety, our aircraft have become increasingly complex and with this complexity, enormously more expensive. We have reached a stage where a two-bit mistake can cause or contribute to the destruction of a multi-million dollar aircraft, not to mention the large loss of human life, attendant costs and personal hardships. It is paradoxical that the more advanced, the

By John A. Margwarth
Lockheed-California Co.
Flight Safety Manager

(This is a synopsis of a presentation made by Mr. John A. Margwarth at the 19th Annual International Air Safety Seminar which was convened in Madrid, Spain, by the Flight Safety Foundation in November, 1966. Although the presentation was largely dependent upon numerous visual aids which do not lend themselves to reproduction, it is believed that the message will still be clear.—*Editor.*)

Big Accidents

more knowledgeable, the more sophisticated we become in the design and operation of our aircraft, the more impact details have upon their safety. We can concentrate assiduously and automatically on the big and the obvious, but small items are equally worthy of our efforts. The little things can be just as deadly and expensive as the big things and, unfortunately, they oftentimes are much more difficult to anticipate.

Prominent in the area of details is Murphy's Law. This is not a new law; it has been with us from the beginning, but its importance in earlier days tended to be obscured or overshadowed by the big and obvious things—such as structural and aerodynamic design. Briefly stated, Murphy's Law says: "If an aircraft part can be installed incorrectly, someone will install it that way." Murphy's Law is well illustrated by such common examples as control cables crossed because their attachments are identical and their proximity permits it; flexible lines crossed because their fittings are close-by and identical; movable components that can be installed backwards and cause system malfunction. Incorrect fluids, fuel, hydraulic oil, water, etc. put into the wrong tank; verbal or written instructions which can be misunderstood, etc. are among these in an endless list of other corollarys of Murphy's Law. All are small things—except for the possible serious consequences.

The books are full of military and civil aircraft accidents in which the initial event leading to a fatal crash was a missing cotter pin, a missing piece of lockwire, crossed control cables, reversed electrical wiring, actuation of a wrong switch, a misunderstood command, etc. etc.

A designer for his part should attempt to design against personnel errors . . . against Murphy's Law. Electrical systems, hydraulic systems, flight controls, replaceable components, etc., when designed so that there is a minimum possibility of installing or operating them incorrectly, will enhance safety. In a large percentage of cases, it is not at all difficult to make a design foolproof, or, in other words, "Murphy Proof."

By contrast, the Navy's newest, the A-6 Intruder, a model of sophisticated instrumentation, stands poised for action off Vietnam.

Realization that an extra dollar spent on safety in the design stage can save thousands of dollars later is not unknown to most of the aviation family. The military safety specifications currently in effect certainly bear this out.

If we are to continue our very good progress in aviation safety we must place ever-increasing emphasis on, and devote adequate time to, the little things.

FOD Facts

Did you know:

• That based on maximum allowed operating time between overhauls, less than 50 percent of maximum operating hour potential was attained on 675 jet engines because of FOD?

• That an average of 64 engines (over a 15-month period) went into premature rework for FOD monthly?

• That 35.6 percent of all J52 engines were damaged by foreign objects as compared to the overall jet engine rate of 20.8 percent?

• That the J79 experienced a 33.6 percent rate?

• That shipboard operations accounted for at least 12.7 percent of FOD engines? (*Some 24.8 percent of the reports did not include base/ship where damage occurred—please submit complete URs).*

• That 21 work days and an average 1140 man-hours were required to rework a J79?

• That 23 work days and average 556 manhours were required for the J65?

• That half of the FOD is people-induced? (Of 207 engines 53 were damaged by nuts, bolts, screws, etc.; 23 by clothing, helmets, ear protectors, goggles, etc.; 25 by tools, flashlights, groundwires, lockpins, etc.; 10 by duct covers.)

• That "top three" stations in the West recorded (54), (46) and (45) FODS.

• That in the East (43), (33), and (31) were recorded and

• That overseas (WestPac) (32) and (29) were the highs?

• That the ingestion of Foreign Objects is a continuing problem with jet operations, resulting in reduced aircraft availability for intended missions, loss of maintenance man-hours and expenditure of critical funds?

• That FOD can be controlled, reduced, and even eliminated?

• That FOD reduction means work reduction?

• That the effort required is well worth it in the light of 275,323 potential operating hours which were lost?—*Based on NATSF Report MRA:189*

MURPHY'S LAW*

RA-5C Murphy

IN the process of installing the Pilot's Projected Display Indicator (Unit 20 of the AN ASB-12 system) in an RA-5C, a technician inadvertently connected plug 20P3 to the All Attitude Indicator (AAI).

Plug 20P3 mates with jack 20J3 (Fig. 2) on the rear of the advisory lights panel on the right-hand side of the PPDI (Fig. 1). Plug P101 connects with jack J101 (Fig. 2) on the rear of the AA1. P101 had slipped off to the side behind the control panel and 20P3 was mistaken for the plug to the AA1 and connected as such.

When power was applied the improper input voltages from 20P3 caused the AA1 to become inoperative.

Factors contributing to Murphying the installation include:

- Close proximity of similar jacks.
- Similarity of jacks permitted mismatched plug to go on with ease and
- An inexperienced technician

Recommendations: Alert others of this Murphy condition and pincoding the jacks differently.

—Contributed by RVAH-11

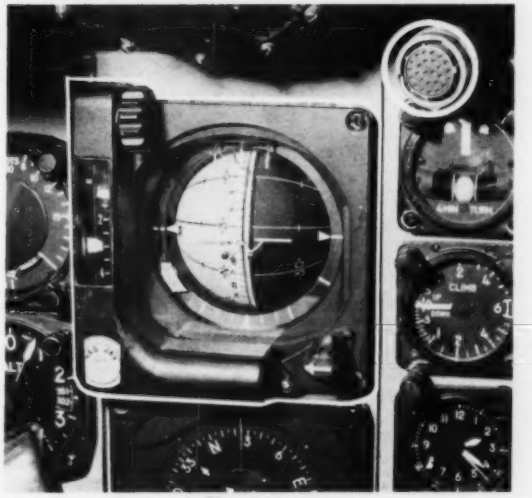


Fig. 1

Plug 20P3 (circled in Fig. 1) mates with jack 20J3 (Fig. 2) on Pilot's Projected Display Indicator. Crossconnection of the plug J101 (fig. 2) to All Attitude Indicator (outlined Fig. 1) resulted in inoperative AA1.

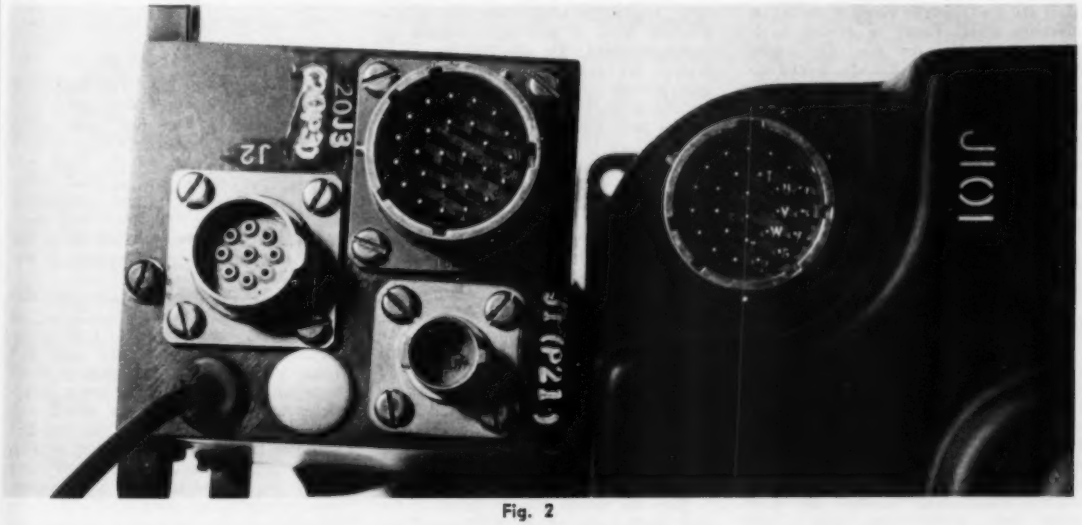
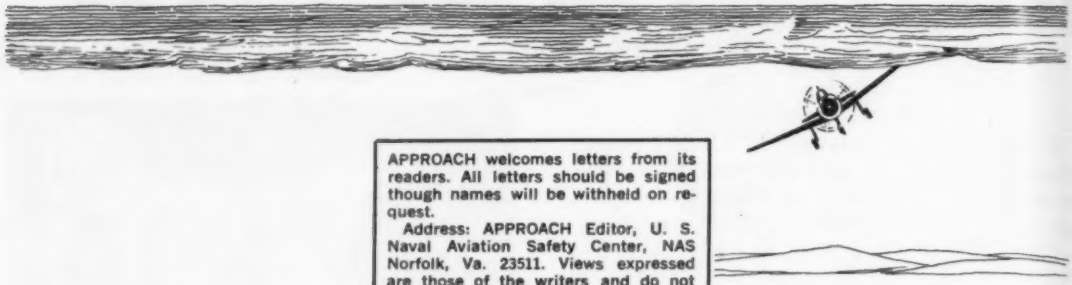


Fig. 2

* If an aircraft part can be installed incorrectly, someone will install it that way!

Letters



APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request.

Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. 23511. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

.38 Revolver

FPO, San Francisco—I have been wondering about the purpose of flight crews carrying the .38 revolver with tracer—we now have in use the survival pencil flare, which in my opinion is a lot more effective. I believe that the .38 is not serving the purpose that it is for, unless used for your own protection, and if a weapon is required, a .45 automatic would be more suitable. Besides this, a pilot or crewman downed over enemy territory should be using E&E methods.

AO2 KENNETH E. HAGENS
VQ-1

• The following excerpt from *General NATOPS* (*OpNavInst 3710.7D*) is current policy on this question:

"All crewmembers in combatant aircraft and single engine training aircraft shall carry a pistol with tracer ammunition for all night flights, and for all flights, night or day, over water or sparsely populated areas. An approved signaling device is authorized as a substitute for the pistol when operational and/or security conditions warrant. The carrying of such an approved signaling device in all other Navy aircraft is encouraged."

The Mk 79 Mod 0 pencil flare kit is an approved signaling device.

Lead Time

NAAS Kingsville—We appreciate the fact that a lead time is necessary for publication of a periodical and on that basis, excuse the erroneous information published in the August "On the Glide Slope." OpNav Inst. 3710.7C has been superseded by 3710.7D. One major change is in alternate airport weather minimums which are now 3000′ and 3 miles ± one hour of the ETA instead of the 5000′ and 5 for ETA + 2 hours. We hope a correction will be printed in the future to prevent confusion.

LCDR D. P. WILSON
AVIATION SAFETY OFFICER

• The supposition of lead time is correct. The August issue had just gone to press when we received our copy of OpNav Inst. 3710.7D. On page 6 there is an article titled "Why Alternate Airports" which deals with the subject matter.

Also, thanks to LCDR D. Luehring, VP-24 for a letter on this same subject.

Pen Gun

FPO San Francisco—LTJG H. W. Dixon's excellent letter in the August 1967 APPROACH about the use of the Mk 79 Mod 0 pen gun cannot be overemphasized. To add to the justification for use of the pen guns, the gun is now being used as a handle for the knife/hacksaw blade contained in the new SEEK-2 packet 2.

LCDR A. P. WEINTRAUB
ASO, VRC-50

Flight Suits

NAAS Fallon, Nev.—A question has arisen at this command concerning the summer flight suit made of flame retardant cotton. *BACSEB 56-61* sets the procedures for properly cleaning this type suit and *NavPers 10358B* (*PR3 and PR2 Manual*) gives instructions on how to retreat the suits for flame retardant capabilities. However, we cannot locate any directive concerning the number of cleanings allowed before the suit must be retreated.

Also we would like to know if the new flight suits made of "Nomex" are going to be procured in a high visibility color such as Indian orange which is being used in the cotton suits. At this command and others a camouflaged suit is a disadvantage in a survival situation.

PR2 PAUL S. ANDERSEN
AVIATOR'S EQUIPMENT SHOP

• Fifteen launderings of flight suits with fire retardant finish are allowed before the suits must be retreated. *Personal Equipment Crossfeed 3-61*, which we have forwarded to you, gives details.

To answer your second question, CNO deleted the requirement for high visibility color flight suits early in 1965 after tests by the Naval Aerospace Recovery Facility indicated that the high visibility flight suit does not provide a significant increase in detectability of a survivor in most situations.

Command Attention

FPO San Francisco—The matter of appropriate flying and flight attire both for appearance, function, and safety has long been a thorn in this writer's side. We are furnished the finest materials, the best in professional assistance and finely engineered equipments for personal carriage, but close command attention to the utilization of this gear and working appearance is frequently missing.

My earliest recollection of this omission goes back some 12 or 13 years to my experience as a flight instructor at Pensacola. My unit had some 190 instructors assigned and we were all flying long hard hours, sometimes as many as 100 per month and greater. Our portion of the training syllabus frequently found us in civilian air terminals. The appearance of many of us was completely out of standard, particularly when contrasted with those established for personnel inspections. Many individuals had large holes in the shoulders of their flight suits with

Corrosion Control?

NAS Quonset Point—Here's a graphic pictorial illustration of lack of corrosion control.

Actually, the engine was recovered in Narragansett Bay by a local fisherman. Even though all identifying plates are missing we believe it to be an R2800 engine with a Curtis-Electric prop. This combination was used on the SB2C.

R. L. WILLIAMS
ASO, COMFAIRQUONSET

underclothing or bare skin shining through or grease and dirt so thick as to make them appear to have been rolling in engine oil. This unsightly picture of naval officers and aviators was not only bad to look at, it was unsafe.

Proper command attention directed to this area could have prevented such a situation. The same applies to the appearance and proper equipping of flight deck personnel. It has long been recognized that men respond to safety and personal appearance in proportion to the interest shown by their leaders.

In view of this and in preparation for my squadron's third combat deployment, a monthly squadron personnel inspection in flight deck clothing, dungarees, and flight gear was held. The following points are stressed in these inspections:

1. Overall appearance.
2. Adherence to prescribed safety regulations in clothing and shoes worn by personnel depending on the job assignment.
3. Completeness of pilot's equipment, including: mirror, SEEK-2 kits, pistol and tracer ammunition, flare gun and ammunition, strobe light (firmly affixed to harness), helmet and visor (condition and appearance), shroud cutter, knife and gloves.
4. Proper marking of safety equipment.
5. Waterproofing of boots, combat soles attached.
6. Date of last check on oxygen mask and flotation equipment.

The inspection proved to be more than successful for the following obvious reasons:

1. The attention of each individual was focused on his personal equipment.
2. An accurate sight inventory of clothing and safety equipment was accomplished. In the case of divisions that were short of flight deck helmets, shoes, or clothing, I required that the division officer have a list of his shortages ready at inspection time. This shortage list, coupled with my personal sighting of men and equipment, gave me the ammunition needed to push a concerted supply effort.
3. Pilots were asked to place their hands on emergency equipment and answer if they felt that it would be accessible if in the water with life preserver inflated or if hung in a tree. Some were a little surprised at their equipments' inadequate accessibility. Pencil flares were a particular problem.

The final and perhaps most beneficial result came from the interest shown by flying personnel in the area of personal survival as manifested by post inspection readyroom discussion.

In summary, the whole evolution proved to be extremely worthwhile and educational both from a command position and from the position of the individuals within the command.

CDR P. H. ENGLE
ATTACK SQUADRON 164

• When commanding officers and other squadron leaders make it clear that they personally accept safety equipment and procedures, safety is promoted as a group value.

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Vol 13 **approach** No 5

Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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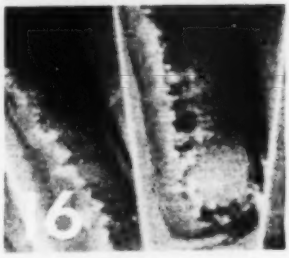

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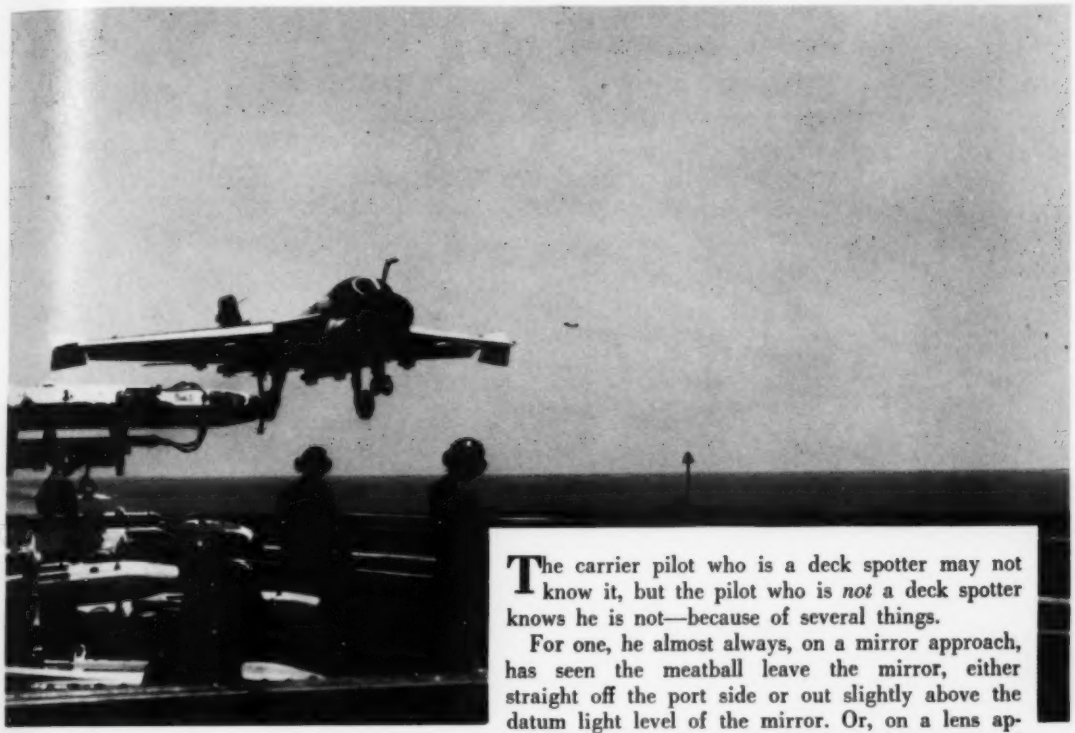

Deck spotters are in for a bad time at night or in pitching deck situations . . .

The View from the Ramp

LIFT and DRAG

The carrier pilot who is a deck spotter may not know it, but the pilot who is *not* a deck spotter knows he is not—because of several things.

For one, he almost always, on a mirror approach, has seen the meatball leave the mirror, either straight off the port side or out slightly above the datum light level of the mirror. Or, on a lens approach, he sees the meatball change from a round blob to an oblong shape. Both these phenomena occur at or just prior to touchdown.

The other means by which a pilot may determine that he is not a deck spotter is that he seldom, if ever, picks up a "one wire"; furthermore, the actual carrier landing, as well as the field touchdown on the meatball, comes as a surprise. The deck spotter, on the other hand, knows the precise split second when he is going to touch down, because he leaves the meatball prematurely when he feels he has cleared the ramp. He spots the deck and makes his play. It is true that many deck-spotting carrier pilots make consistently good landings under ideal conditions. But the deck spotter is in for a bad time when night falls and/or the deck is pitching, and even under the best conditions he probably gets more one wires and bolters than the pilot who is set up on a glide slope interception and flies the ball smoothly to touchdown. The deck spotter makes more hard landings also.

If you habitually spot the landing area by taking your eye off the mirror just prior to touchdown, you should learn not to, and then you will join the ranks of the true professional carrier aviator.

—VT-5 Safety Sense, June 66